

# Effects of EU policy regulations on ferry operation

Sustainability issues in public procurement of ferry services

Final report

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# Sustainability issues in public procurement of ferry services

## Executive summary

### Short description of the output

This report brings together the activity from the Institute for Sustainability and UCL Energy Institute to explore the effects of EU policy regulation on ferry operations. UCL Energy Institute investigated the sustainability issues related to public procurement of ferry services in the North Sea Region. This report identifies the key drivers for public procurement and identifies some of the challenges that ferry operators and procurers can face. The report begins with a brief overview of the procurement process in EU and the problems that are currently being faced in the EU ferries sector.

This report highlights how different types of ‘split incentives’ can stymie attempts to improve quality or sustainability of ferry services through the tender and procurement process.

Policy recommendations that can avoid, alleviate or minimise the issues of split incentives include:

- Policies that target the design based efficiencies, such as the EEDI
- Policies that incentivise the improvements in operational or in-service efficiency of ferries
- Revisiting some aspects of public procurement and standardising them for uniform application across all the member states

This report, coupled with the iTransfer Ferry Toolkit, produced by SEStran, forms a comprehensive guidance to all operators and procurers of ferry services in the North Sea Region and beyond.

This report is part of iTransfer, a North Sea Region Interreg programme project, which is funded by the European Regional Development Fund. For more information visit [www.itransferproject.eu](http://www.itransferproject.eu)

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## 1 Introduction

Ferries play an important role in the transportation of people and goods. Globally, it is estimated that over two billion passengers, 252 million cars, 677,000 buses and 32 million trailers were carried in around eight million trips globally in 2009 (Wergeland 2012). It is difficult to define the ferry market as it constitutes of various overlapping segments, as shown in **Error! Reference source not found..** The European region is one of the most ferry intensive markets accounting for 35% of global passenger traffic volume and between 60% to 80% for global vehicular traffic volumes, concentrated around the Northern Europe, the Baltic and the Mediterranean regions, with Greece being one of the largest ferry nations (Wergeland 2012).

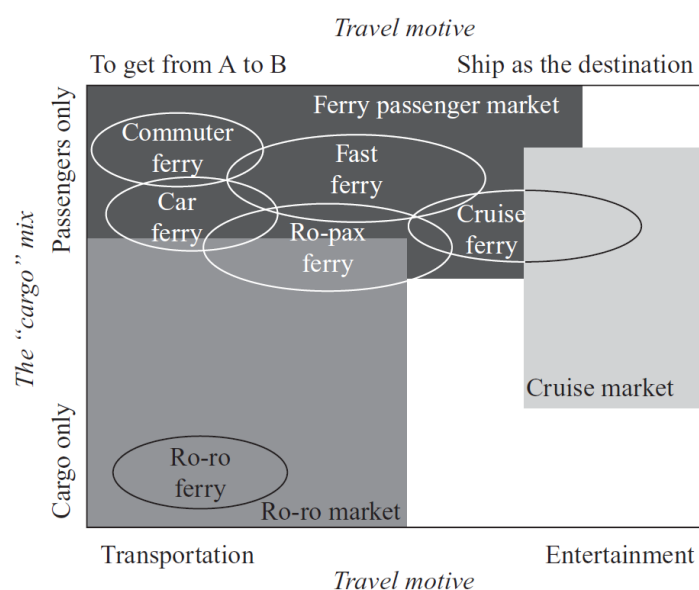


Figure 1: Defining the ferry market

Source: Wergeland (2012)

The long-term viability of the ferry industry is dependent on its various interconnections with ecological, environmental, economic and human systems. There are myriad issues that the industry is currently facing and would be facing in the future. These issues are both local and global, ranging from air pollution to noise pollution and from human safety to marine biodiversity. Some of the key environmental issues that are affecting the ferry industry are:

- Air quality at ports
- Greenhouse gas emissions (GHG's)
- Introduction of native and non-native invasive species
- Erosion due to vessel wake
- Collisions with cetaceans
- Risk of collisions and spillage and detrimental effects on water quality
- Litter from ferry passengers

Perhaps the most pressing issue for the industry are GHG emissions causing climate change and its mitigation. The Ropax and pax-only<sup>1</sup> fleet represented just under 3% (28 million tonnes) of the emissions from shipping in 2012 (Smith et al. 2014). To that effect, the International Maritime Organisation (IMO), the EU and the member states have agreed to various targets, to which the EU ferry sector will be subject. For example, the EU has key policy and strategy documents in the form of white papers and sector strategic communications and newly proposed legislation namely;

- 2009-2018 maritime transport strategy (European Commission 2009)
- Single EU transport policy roadmap (European Commission 2011)
- EU integrated maritime policy/strategy (European Commission 2012)
- Monitoring Reporting and Verification regulations (European Commission 2013a)
- EU ship recycling regulation (European Commission 2013b)
- Integrating maritime transport emissions in EU GHG reduction policies (European Commission 2013c)

The UK, through its Climate Change Act 2008, has agreed to 80% reduction of CO<sub>2</sub> emissions below 1990 levels by 2050 and it is expected that shipping (including the ferry sector) will be part of the budgeting framework to deliver the 2050 target. Similarly, the Scottish Government climate change policy aims to reduce GHG emissions, including a 50% reduction by 2030 and 80% reduction by 2050.

## 1.1 Aims and objectives

This report forms part of the delivery of the iTransfer INTERREG project. iTransfer (Innovative Transport Solutions for Fjords, Estuaries and Rivers) aims to make ferry transport more freely accessible and sustainable, and encourage more people to travel by water. In areas in the North Sea Region (NSR) there are opportunities to replace existing vehicle routes with passenger ferries as a viable alternative. Travelling by ferry is more sustainable, easier and quicker. It can also provide lifeline services to remote communities.

This report aims to examine EU ferry policies with specific focus on public procurement and tendering of ferry services in the North Sea Region and the sustainability issues (specifically energy efficiency and GHGs) in the procurement of ferry services.

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<sup>1</sup> RoPax is a vessel that carries cars as well as passengers, Pax-only carries passengers only

## 2 EU ferry policy and regulations

Desk research was completed by the Institute for Sustainability to identify policies relating to ferry operations, however little was found at regional and national level. At an EU level, no specific directives for ferries were identified, rather a number of transport documents which set the wider context, including:

- 'A Sustainable Future for Transport' (June 2009): Looking at developing an Integrated, technology-led and user-friendly transport system.
- 'Maritime Transport Strategy 2018' (January 2009): Identifies key areas where action by the EU will strengthen the competitiveness of the sector while enhancing its environmental performance.
- 'Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system' (White Paper, 2011): a roadmap to build a competitive transport system that will increase mobility, remove major barriers in key areas and fuel growth and employment. At the same time, the proposals will dramatically reduce Europe's dependence on imported oil and cut carbon emissions in transport by 60% by 2050. This includes the key goal of a cut of at least 40% in shipping emissions by 2050.

At national and regional level, the lack of specific policy was confirmed through discussions with iTransfer partners at a policy workshop hosted by Damen Shipyards in May 2013 and in subsequent exchanges with partners. The area is only very broadly covered in more general transport, maritime and ports policy documents with no specific directives on ferries. The one exception at regional level is the Scottish Ferries Review and Plan.

The 'Scottish Ferries Review' was initiated by the Scottish Government in June 2008, leading to the Scottish Ferry Plan of 2012 providing a long term strategy to 2022.

The review recognised:

- the key role of ferries in sustaining and enabling economic development
- the lack of consistent approach to the funding and procurement of ferry services
- the lack of consistent approach of who should be responsible for the delivery of ferry services
- there was no existing policy to determine what services and routes should be funded, or what the level of service should be.

The aims of the Plan:

- to provide a shared vision and outcomes for ferry services in Scotland, in the context of the Government's Purpose, Economic Strategy and National Transport Strategy
- to analyse the current lifeline ferry services and network, identifying how well it meets the proposed outcomes and how it links to other modal networks
- to inform the Scottish Government's long term plan for lifeline ferry services in Scotland and influence the next round of procurement of ferry service.



- to identify policies to be taken forward to deliver the long term plan, including the planned investment framework.

iTransfer partners have found this approach of great interest. However, as discussed in the workshop, the Scottish model is fairly unique and difficult to apply to other countries. This raised the question of whether the lack of policy is actually exacerbating procurement and operational issues identified elsewhere.

There are various policies and regulations relating to emissions control of the shipping sector that do affect ferry operators and the industry. These include IMO and EU MARPOL regulation or sulphur Directive (SECA); monitoring, reporting and verification (MRV); Energy Efficiency Design Index (EEDI). The influence of policy on efficiency, procurement and tendering are discussed in UCL's Sustainability issues in public procurement of ferry services and SEStran's Ferry tendering toolkit (available at <http://www.itransferproject.eu/ittransfer-impact/project-results/tendering-ferry-services/>)

The influence of policy and regulation on design for new vessels and management of existing fleet operations have been discussed by partners at transnational design workshops held by Damen and TESO. In order to ensure their ferry fleets will meet the forthcoming requirements related to emissions and efficiency, ferry operators need to consider future fuel strategies for both their existing and new vessels. Sustainable vessel design has focused on reducing energy requirements, through hull design, efficiencies of hotel load, however fuel decisions have been related to infrastructure and technology available, and we have seen that the economics of different fuel strategies vary with location. For example, LNG was the most efficient fuel choice for Damen, and CNG favored by TESO. Outside of the iTransfer partnership other operators have found hydrogen vessels economic to develop (CMAL, with EU subsidy support)

### 3 Cross project implications matrix

There are various policies and regulations that affect ferry operators and the industry. These include IMO and EU MARPOL regulation or Sulphur Directive (SECA); monitoring, reporting and verification (MRV), Energy Efficiency Design Index (EEDI). These will affect all areas of marine transport and logistics, not ferry services alone.

From our research we have identified that design of new vessels, retrofit and efficiency of existing vessels, infrastructure and supply of fuel, and wider impacts such as emissions of greenhouse gases and pollutants, are challenging areas for the industry as a whole.

To identify common themes and priorities of emerging policies we have looked to other projects and programmes, and their findings related to different aspects of maritime transport and the we present the combined research and recommendations from these projects below (Table 1).

The Maritime Transport Cluster<sup>2</sup> Policy Paper “Maritime Transport and Future Policies - Perspectives from the North Sea Region” is a compilation of results generated by the North Sea Region Programme project Maritime Transport Cluster in 2011/12. It comprises an analysis of all transport related projects within this programme, maritime transport research and the results of a consultation with the maritime industry in the North Sea Region.

LO-PINOD project has focused on building an efficient, balanced and sustainable transport network by challenging existing thinking on freight distribution and offering more sustainable and efficient alternatives .

Clean North Sea Shipping<sup>3</sup> objectives has been to improve the environmental and health situation caused by air pollution and greenhouse gases from shipping along the North Sea coast and within North Sea ports.

Low Carbon Shipping – A Systems Approach<sup>4</sup>, was a research project funded by the UK Engineering and Physical Sciences Research Council (£1.7m) and a number of industry partners to develop greater understanding of global shipping systems and the complex interplay between principal components (port operations, owner/operator relationships, ship design) to identify concepts for cost-effective reduction of carbon emissions and future trends for technical impacts and policy solutions.

The collaboration has continued into the Shipping in Changing Climates, a recently initiated research project funded by the UK Engineering and Physical Sciences Research Council (£3.5m funded for 3.5 years), Lloyds Register, Rolls Royce, Shell, BMT and MSI . The SCC project seeks to understand the scope for greater energy efficiency of the supply side, understand the demand side drivers and understanding the supply and demand interactions in shipping.

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<sup>2</sup> <http://www.maritimetransportcluster.eu/>

<sup>3</sup> <http://cnss.no/>

<sup>4</sup> <http://www.lowcarbonshipping.co.uk/>

Weastflows<sup>5</sup> is an Interreg IVB North West Europe (NWE) project funded by the European Regional Development Fund (ERDF) that aims to encourage a shift towards greener freight transport in the NWE region. Efficient and sustainable freight transport is essential to help deliver economic, social and environmental benefits to communities and businesses.

Table 1 Core issues for sustainable transport, policy and regulations and outcomes from different EU projects and programmes.

Project	Design of new vessels	Retrofit and efficiency of existing vessels	Infrastructure and supply of fuel	Wider impacts
iTransfer	Sustainable ferry design approaches completed to enable reduced emissions and meeting SECA	Eco drive principles and behaviour change can improve fuel efficiencies	Suitability of alternative fuels (LNG, CNG, H <sub>2</sub> , hybrid) explored. Choices depend in infrastructure availability	LNG and CNG bunkering can lead to methane emissions, a more potent greenhouse gas than CO <sub>2</sub> .
Maritime transport cluster recommendations	Support investment into sustainable maritime transport Continue to focus on development and efficient use of green technology Prioritise research into ship design and environmental impacts of marine transport.	Accessibility is a priority and further projects to develop efficient transport are needed. Focus on issues of ship recycling Promote incentive schemes to improve environmental performance	Focus on green infrastructure provision (eg LNG, on-shore power supply)	Integrate ports with hinterland to facilitate efficient connection of sea and land transport Ferries have impact on territorial cohesion, accessibility and regional development so should be prioritised for future funding Increase co-operation between local, national and European research initiatives
Low Carbon Shipping Forum	The project looked into various innovative and energy efficient designs of new ships from the naval architecture and marine engineering perspective, which fed into the ship impact model. The ship impact model could then be used to identify impact of technologies on the ship design in a holistic sense and act as an interface between the technology assessments and the global shipping model.	Operational efficiency measures were shown to be of significant importance to transition towards low carbon shipping. The relationship between the ship speed and power requirements to propel the ship presents a substantial opportunity for energy efficiency. Survey of 150 shipowner-operators showed that not all operational measures were being implemented and the measures with highest fuel saving potential had between 50-70% implementation rate	A shift to LNG offers significant improvements but also requires major changes in ship design and shipping infrastructure, and still can only deliver modest reductions in transport carbon intensity. Bioenergy is expected to be supply-constrained, solar energy provides insufficient power outputs, and the evaluation of the potential of wind-assistance shows that its potential and future role remain uncertain.	Given the expected long-term growth which is the backdrop to the emissions trajectories of the shipping industry, the changes investigated in the project are unlikely to achieve progress proportionate to shipping's responsibilities (as taken from the Copenhagen Accord) under the current tendency towards 'business as usual'. There is therefore a need to develop further voluntary measures or regulation (market-based or command and control measures).

<sup>5</sup> <http://www.weastflows.eu/>

Project	Design of new vessels	Retrofit and efficiency of existing vessels	Infrastructure and supply of fuel	Wider impacts
Clean North Sea Shipping	Proposed postponement of NOX limitations for new build ships will lead to between 11-15% higher NOX concentration in NSR	Improved incentive/indexing schemes through implementation of MRV LNG reduces emissions of all air pollutants, while scrubbers reduce sulphur emissions only and increase fuel consumption. EU funds should support retrofitting of ships to reduce NOX & PM.	Development of onshore power supply and LNG bunkering is lagging behind ships needs Incentive schemes should be used on large scale for development of clean harbours	Methane slip from LNG is an issue that needs to be minimised Differentiated port dues should be mandatory and standardised for all harbours
LO-PINOD		Costs associated with meeting SECA discussed, including €1m cost for retrofit of scrubber technology	Regional ports are keen to explore bunkering of alternative fuels to diversify port operations and create business opportunities	Scrubbing and exhaust treatment technologies to enable MGO to meet Marpol are energy intensive, reduce fuel efficiency and increase CO <sub>2</sub> emissions.
E-Harbours			Translates Smart Grid best practise into policies and near future planning by identification of obstacles and lessons learned	Provides overview of smart grid applications and quantifies environmental and financial viability of smart grids and electric mobility
WeastFlo ws		Policy advisory group have been considering the impacts of SECA on freight routes and modal shift.		Focus on ICT mapping and routes to develop green supply routes and encourage modal shift

## 4 The procurement process for ferry services

This section discusses the fundamentals of the EU ferry tendering policies and processes that are thought to give rise to the issues relating to sustainability of ferries in the EU region.

Economic theory suggests that given certain assumptions (e.g. free entry and exit, known prices) competitive markets will cause efficient resource allocation (Begg & Ward 2009). When any one of these assumptions is violated, market failures will result and there would be a need for public sector intervention (Sorrell et al. 2004). The ferry market is an example, where in certain cases markets are not perfectly competitive making them economically unviable and as a result there is a lack of services provided in that market. From a public sector perspective the delivery of ferry services to such markets poses a dilemma. The public sector may seek to guarantee a minimum level of service to a particular community even though such a service might not be commercially viable but at the same time the public sector needs to secure an operator that provides a continued service at an efficient cost level, but with the lowest subsidy rate possible, whilst also ensuring that important aspects of service quality are maintained or improved (Baird & Wilmsmeier 2011), such as the lifeline ferry services which operate to isolated communities in Scotland.

Thus, an EU member state can impose a Public Service Obligation (PSO) in order to ensure an adequate regular ferry service to and from a given location where operators, in considering their own commercial interests, would not provide an adequate level of service or under the same conditions (Baird, Wilmsmeier & Boglev 2010). A PSO would include the ports to be served, regularity, continuity, frequency and capacity, rates to be charged and manning of vessels. PSOs can be imposed through Public Service Contracts (PSC) with individual operators on a given route or through a licensing system for all operators on a given route. At times it is not clear as to which instrument comes first in order to justify public intervention, but the commonly held view is that a PSO is established first and followed by a PSC with a specific operator, although in some cases a PSO can be defined within the PSC<sup>6</sup>. The PSO and the PSC therefore are the basis on which compensation for operation in economically unviable<sup>7</sup> route is to be given.

### 4.1 Regulations

The procurement of ferry services within the EU needs to be compatible with national and EU law. The EU council regulation No. 3577/92 (the Cabotage regulation) regulates the transportation of passengers and goods by sea between two points within member states of the EU. The essence of the regulation is to allow free movement of services and enable operators to operate freely within the European market. Recognising the needs for transport of passengers and goods of certain islands, exceptions to the free movement are allowed, giving member states power to intervene by imposing PSOs and providing compensation to operators through PSCs. The 'Cabotage Regulation' requires that, for both imposing PSOs and concluding PSCs, the Member State shall do so in a non-

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<sup>6</sup> For example in the case of Altmark, the EC concluded that PSO's were clearly defined in the PSC for Clyde & Hebrides and Northern Isles contracts.

<sup>7</sup> This is identified if no operator asks for operating permission on a specific route

discriminatory basis in respect of all community shipowners<sup>8</sup> (operators) and therefore any compensation must be available to all community ship owners. The interaction of EU regulations and the actions of national bodies is outlined in Figure 2.

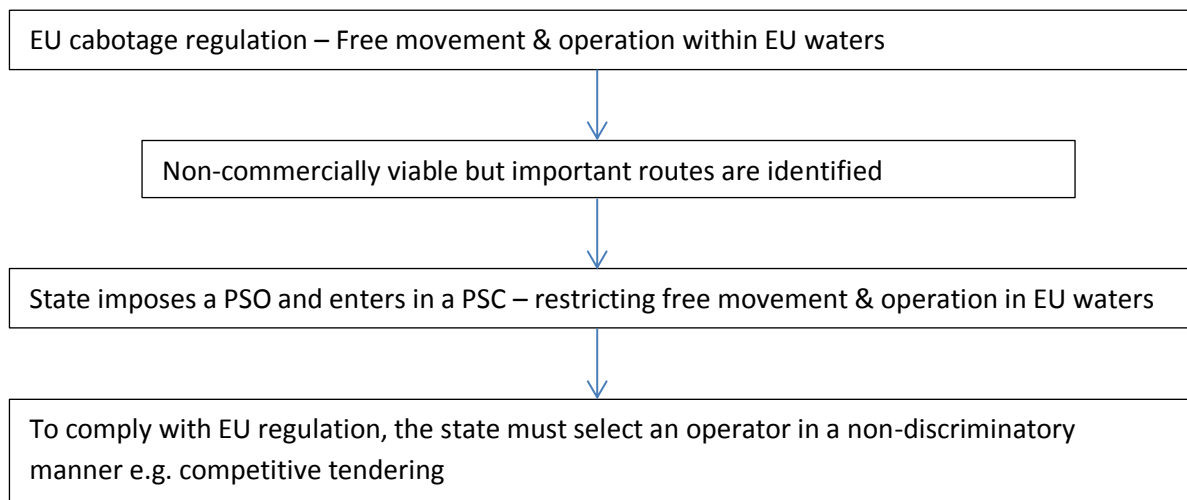


Figure 2: EU regulations and actions of governments in procurement of ferry services

## 4.2 Subsidies

Operators (referred to as ‘community ship-owners’ in EC regulation) are entitled to apply for compensation in exchange for accepting PSOs and since prices are insufficient to make the services economically viable, ferry companies receive government subsidies. Careful consideration needs to be given to subsidies as they can fall foul of EU restrictions on state aid, thus the process of granting subsidies needs to comply with the four ‘Altmark’ criteria;

1. The receiving undertaking must actually have PSOs to discharge and these must be clearly defined;
2. The basis of compensation must be calculated in an objective and transparent manner;
3. Compensation cannot exceed what is necessary to cover the costs in discharging the PSO - taking into account relevant receipts and a reasonable profit;

<sup>8</sup> Defined as (a) nationals of a member state established in a member state and pursuing shipping activities; (b) shipping companies of a member state and whose principal place of business is situated, and effective control exercised, in a Member State; or (c) nationals/shipping companies of member state established outside the community and controlled by nationals of a member state, if their ships are registered in and fly the flag of a member state

4. If the undertaking concerned is not chosen under a public procurement procedure, then the level of compensation needed must be determined on the basis of an analysis of costs which an efficient undertaking would have incurred.

The above criteria give rise to several questions and especially the last two criteria have the potential to affect the sustainability of the ferry services provided. There are two main types of subsidies; net subsidy and gross subsidy contracts. In a net subsidy contract the ferry operator is granted all the revenue to cover the costs of operation and therefore the subsidy will only be for the difference between revenue and the acceptable profit. Net contracts therefore give the operators an incentive to increase revenue. Airlines and ferry routes are typically operated on net contracts.

In a gross subsidy contract the operator collects the fares on behalf of the government/authority. That is, the companies operate on 'gross cost' contracts in which each company receives a subsidy from the government in order to cover their costs. The operator bids for the full operating costs, and all revenue goes to the authority. The use of gross contracts reduces the risk of the operator since they do not need to estimate demand and will normally give lower bids since there is a lower risk premium in each bid. This option also makes it easier to create free transfer between operators. In Sweden gross contracts are the dominant contract form. The Norwegian experience has shown that gross cost term contracts have higher transaction costs and lack incentives for companies to enhance demand and consequently revenue (Baird, Wilmsmeier & Boglev 2010).

### 4.3 Tendering

Tendering has been suggested as a means to induce cost efficiency and thus reductions in the costly subsidies (Sunde 1999). The Commission takes the view that any public service contract is potentially discriminatory between community ship-owners. As such, the Commission considers that launching an open, community-wide procurement process is the best way to ensure non-discrimination, regardless of whether national or EU procurement law requires such an approach. Thus tendering can be viewed as creating competition for access to a market at set point in time instead of continuous competition within the market. Ferry tendering is covered by two EU public procurement policies;

- Directive 2004/17/EC of the European Parliament and of the Council of 31 March 2004 coordinating the procurement procedures of entities operating in the water, energy, transport and postal services sectors (30.04.2004).
- Directive 2004/18/EC of the European Parliament and of the Council of 31 March 2004 on the coordination of procedures for the award of public works contracts, public supply contracts and public service contracts (30.04.2004).

There are several types of tenders, details of which are provided in SEStran's Ferry Toolkit, however it should be noted that the only permissible criteria for award of a public contract are; lowest price or most economically advantageous tender (MEAT), both of which have potential for affecting the

sustainability choices made in provision of ferry services. MEAT must include price and some aspects of quality, such as:

- Deliverability of the services within the agreed time scale
- Technical merit and innovation
- Level of risk accepted by the tenderer
- Proposals relating to health and safety
- Proposals of dealing with environmental issues (protection of the environment)
- Service assistance
- Social considerations - positive action towards disabled persons, promotion of equality between men and women and promotion of ethnic/racial diversity.

When awarding a contract on MEAT which is the more commonly used, the criteria must be weighted either as an exact number (e.g. price: 25%) or within a meaningful range (e.g. price: 20%-30%). As an example, in Denmark the selection criteria have evolved from lowest price to MEAT in the 3<sup>rd</sup> round, with price weighted at 70%, flexibility, frequency and security weighted at 20% and ferry quality at 10% (Baird & Wilmsmeier 2011).

A subsidy corresponds to the bid which is a function of future revenues, future costs and a reasonable profit. The winning bid which may be the lowest bid or MEAT bid would aim to increase revenue and reduce costs, given PSO and PSC constraints on revenue through the Altmark criteria. The criteria suggest that compensation cannot exceed what is necessary to cover the costs in discharging the public service obligation - taking into account relevant receipts and a reasonable profit and If the undertaking concerned is not chosen under a public procurement procedure, then the level of compensation needed must be determined on the basis of an analysis of costs which an efficient undertaking would have incurred (Baird, Wilmsmeier & Boglev 2010). Future costs are directly related to energy efficiency (as shown in 4.6), both technological and operational, therefore the definition of 'reasonable' costs and profits should preferably include energy efficiency considerations.



## 4.4 Transnational comparative analysis: co-financing for different public transport modes in the NSR

When tendering for ferry services the scope and scale of subsidies available can affect the attractiveness of different routes for prospective operators. Subsidies can also affect the delivery of sustainable ferry services.

When it comes to good practise for tendering for bus services in the UK, it is recommended that the minimum level of subsidy should be included in the invitation to tender<sup>9</sup>.

The UK Department for Transport recognises that public subsidy arrangements can be useful to kickstart commercial road transport operations, such as tapering financial support over a short period (typically three years) intended to deliver services that are commercially viable upon completion<sup>10</sup>.

The same report recognises the potential for public sector and operators to share rewards as well as risks of services. In the UK this typically applies to provision of park and ride services, or where existing routes aren't available so the commercial viability of such routes are untested.

Research on German rail company tenders has identified that on average 11 companies requested tender documentation but an average of only 4 bids were submitted. The evidence<sup>11</sup> suggests two factors will influence the number of bidders. Number of bidders increases with percentage of risk assumed by the public transport authority for price increases on input factors like personnel or fuel; and the level of revenue risk to be assumed by the operator. A high level of uncertainty will reduce authorities' efficiency gains by reducing competition and making it necessary for operators to calculate an increased risk premium.

This evidence from German rail tenders shows that authorities using competitive tendering processes should be aware that uncertainty can influence operators' interest in submitting tender returns. Therefore tenders should avoid placing excessive risks on operators as this will reduce their efficiency gains and by implication their sustainability improvements. Failure to do so can result in reduced competition and fewer returns, but also higher value returns based on higher risk and uncertainty. In order to successfully deliver sustainable operations tenders should aim to reduce risks and uncertainties for operators to encourage high numbers of competitive bid returns.

One key difference between road and ferry transport:

- Investment costs. The average cost of a new bus is €445,000<sup>12</sup>, while a new ferry can cost €34m<sup>13</sup>. Given that a bus tender may be for service provision of 3 years, a competitive case

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<sup>9</sup> <http://webarchive.nationalarchives.gov.uk/+http://www.dft.gov.uk/pgr/regional/buses/tendering/enderinggoodpracticeguid3582.pdf>

<sup>10</sup> [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/254392/tendering-road-passenger-transport-contracts.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/254392/tendering-road-passenger-transport-contracts.pdf)

<sup>11</sup> [http://www.ejtir.tudelft.nl/issues/2011\\_01/pdf/2011\\_01\\_01.pdf](http://www.ejtir.tudelft.nl/issues/2011_01/pdf/2011_01_01.pdf)

<sup>12</sup> <http://www.mayorwatch.co.uk/tfl-reveals-cost-of-new-bus-for-london-fleet/>

can be built to allow for investment in vehicles, especially where there is subsidy, kick-start funding or shared risk/reward arrangements. For ferry services tendered under the similar circumstances a competitive business case is harder to establish, especially with the considerable costs of the vessels.

- Infrastructure requirements. An added complication may arise on the bespoke nature of ferry landings. Each port or quay may have different infrastructure, so operators may not be able to move vessels between routes as easily as bus operators.

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<sup>13</sup> [http://www.itransferproject.eu/media-lib/Key-Achievements-and-lessons-learned\\_Integration-tendering-and-policy.pdf](http://www.itransferproject.eu/media-lib/Key-Achievements-and-lessons-learned_Integration-tendering-and-policy.pdf)

## 4.5 Procurement flow chart

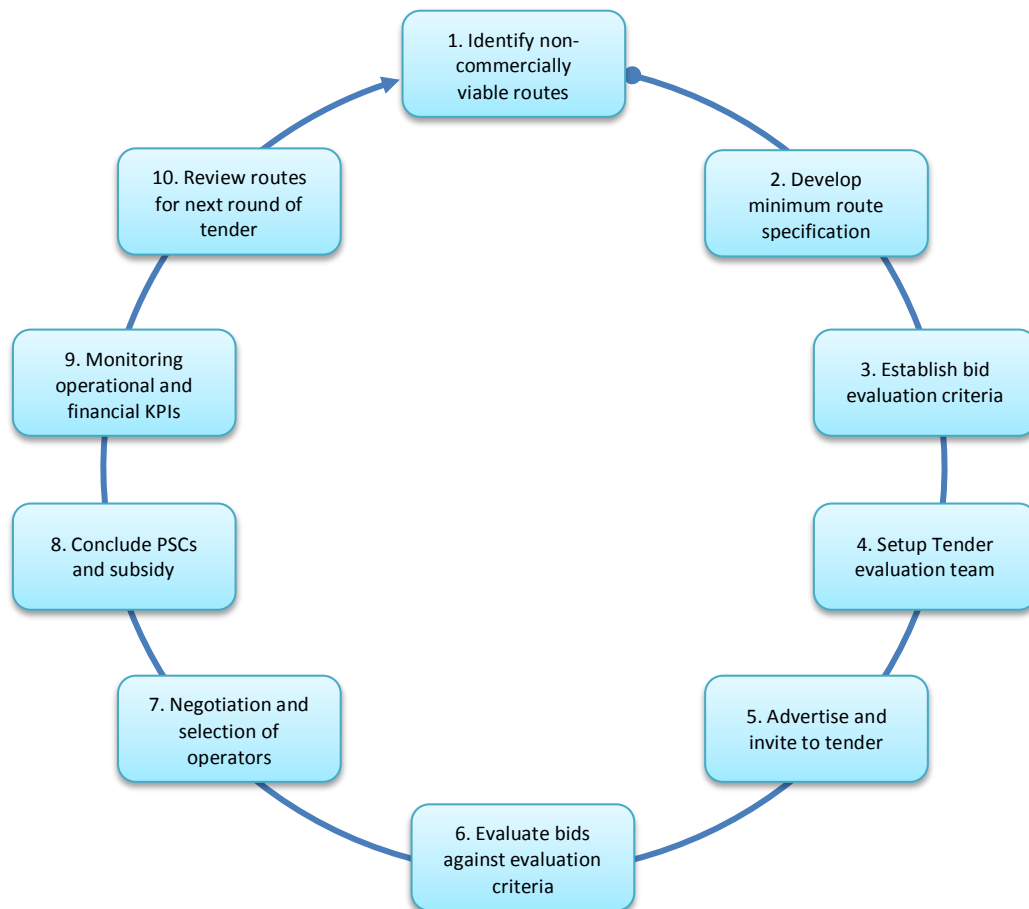


Figure 3: Public procurement process of ferries

## 4.6 Measures to improve energy efficiency

As mentioned in the Introduction, one of the key environmental issues affecting the ferry industry is that of GHGs. Several methods have been identified for improving energy efficiency, thereby reducing GHGs and mitigating effects of climate change. Generally these options have been classed as either technical or operational fuel saving measures<sup>14</sup>. It is suggested that fuel costs in shipping generally account for 50% of a ships operating costs, a share which is set to increase as fuel costs increase, generating an even greater incentive for the implementation of energy saving and CO<sub>2</sub> abatement measures (Baird, Wilmsmeier, & Boglev, Scottish Ferries Review, Part A: Methods of ferry delivery and operation, competition and procurement, and environmental issues, 2010). Thus, if a vessel is able to improve its energy efficiency it will result in lower fuel bills and direct CO<sub>2</sub> emission reductions, resulting in a win-win situation. It has been suggested that the potential for saving

<sup>14</sup> 1 tonne of Heavy Fuel Oil (HFO), most commonly used fuel on board ships, is equivalent to 3.14 tonnes of CO<sub>2</sub>

energy and emissions (as shown in Table 2) using known technology and practices are significant and in the range of 25% - 75% (Buhaug, et al., 2009). More than fifty measures have been identified that could result in efficiency gains and they are generally grouped as technical measures (some applicable to new and some to existing ships/retrofits) and operational measures.

	Saving (%) of CO <sub>2</sub> /tonne-mile	Combined	Combined
DESIGN			25 – 75%
Concept, speed & capability	2 – 50%*	10 – 50%	
Hull and superstructure	2 – 20%		
Power and propulsion systems	5 – 15%		
Low-carbon fuels	5 – 15%**		
Renewable energy	1 – 10%		
Exhaust gas CO <sub>2</sub> reduction	0		
OPERATIONS			
Fleet management, logistics & incentives	5 – 50%	10 – 50%	
Voyage optimisation	1 – 10%		
Energy management	1 – 10%		

\* Reductions at this level would require speed reductions

\*\* CO<sub>2</sub> equivalent based on the use of LNG

Table 2: Assessment of options for reduction of CO<sub>2</sub> emissions from shipping

Source: Buhaug et al. (2009) IMO 2<sup>nd</sup> GHG study

Newer ferries could make a significant contribution to the environmental objective, by reducing CO<sub>2</sub> emissions through energy-efficient hull design, energy efficient engines, lower-friction hull coatings, on-ship energy efficiency systems and greater use of low carbon technology (e.g. bio-diesel and hybrid powered engines). Existing ferries could also make a significant contribution to the reduction of CO<sub>2</sub> through changes in operational practices, use of weather routing, autopilot adjustments etc. (see iTransfer [Ferry Operations case Study](#) and [Ferry Design case study](#)).

## 4.7 Problem context

Time series analysis from Baird & Wilmsmeier (2011) and Baird, Wilmsmeier & Boglev (2010) of several EU member states has shown that ferry subsidies have been rising despite the competitive tendering of ferry services introduced in many EU member states. Tendering procedures that are thought to improve the prevalent ferry services in terms of value for money for the consumers and public agencies is not yielding the desired or expected results. Moreover research from Førsund (1993), Minken & Killi (2001), Bråthen et al. (2004) and Odeck & Bråthen (2007) show that there are unrealised cost efficiency gains in the range 10% - 30% in the EU ferry links analysed. Brathen et al. (2004) also show that tendered ferry links did not outperform non-tendered ferry links and that the subsidizing authorities do not seem to impact on the performance of ferry links. These findings have important implications on the efficacy of the public procurement of ferry services through tendering, as they suggest production costs (e.g. labour, capital, fuel) are not minimised, therefore suggesting that energy efficiency savings may be forgone in certain situations.

Although there is no substantial evidence on this subject in the context of ferry services, some evidence can be gleaned from existing analysis. In Greece, where the state does not get involved with the ownership of the vessels, non-commercially viable routes that are subsidised by the state attract older ferries of ‘lower’ quality (Baird, Wilmsmeier, & Boglev, *Scottish Ferries Review, Part A: Methods of ferry delivery and operation, competition and procurement, and environmental issues, 2010*). The same can be said for Scotland, where the state is heavily involved in the ownership of vessels (through CMAL), the average fleet age is nearing replacement age and in some routes beyond their useful economic life of circa 25 years. In contrast, better quality vessels are deployed in profitable and competitive routes that carry significant tourist and local traffic, as well as commercial traffic in Greece. This suggests that, despite being subsidised, uneconomic routes offer reduced return for operators and that public procurement of ferry services does not create the right commercial environment so as to incentivise investment in energy efficiency by operators.

From the small islands perspective, several islands (including Orkney and Bornholm) have shown that the public procurement tendering procedure given in community legislation for the implementation of PSO has not, for various reasons, given good results, and seems to have created more problems than it has solved, such as drops in the quality of service, costs which are higher at the end of the day, conflicts, etc. (Islands Commission, 2005)

Despite the low cost and MEAT tendering criteria, it seems that energy efficiency of ferries is being overlooked, for example when factors such as speed and age of vessels are decided upon in the tendering process. As such there is a lack of standardised application of EU policy on the subject of ferry procurement by member states in their PSOs and PSCs, for example, duration of PSCs range from one (Greece) to twenty years (Italy).

There is currently a strong need for the renewal of the EU’s ferry fleet<sup>15</sup>. Figure 4 shows that almost half of the EU flagged ferries are above the age category 21 – 25 and Figure 5 shows that the average age of the existing EU flagged fleet is around 25 years. This suggests a sizeable opportunity exists in the renewal of the fleet at the target renewal age, although the actual renewal age is around 30 years in the EU (Grant Thornton, 2010). The replacement of the ageing fleet will bring to market several energy efficiency technological innovations which itself creates fuel efficiencies of around 10% when comparing ships from 1980 to 2010 (Grant Thornton, 2010). Research by Odeck & Bråthen (2007) indicates that the vintage year has a direct impact on the efficiency of ferries and the most likely explanation again is that newer ferries are more fuel efficient than older ones.

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<sup>15</sup> Defined by flag states, which may under-represent the actual number of ferries in operation in EU waters.

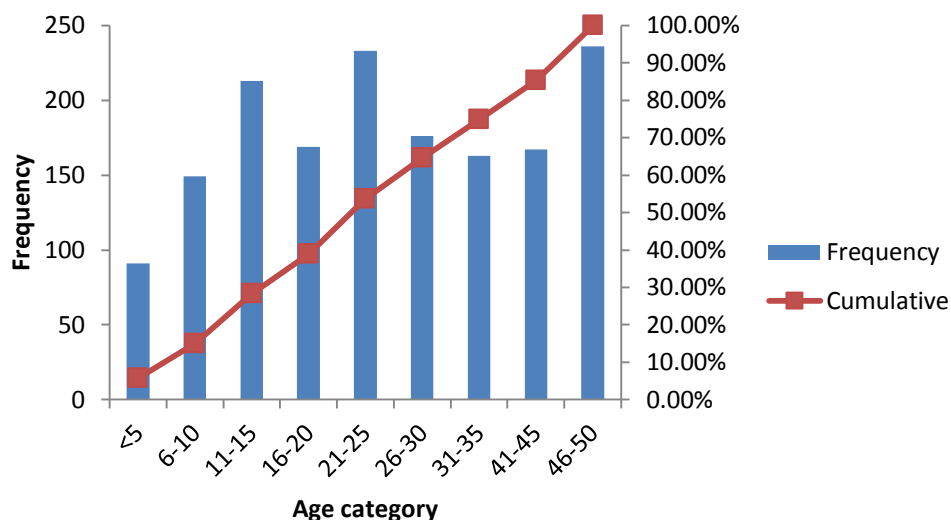


Figure 4: Distribution of EU flagged ferries<sup>16</sup>  
Source: Clarksons World Fleet Register (2014)

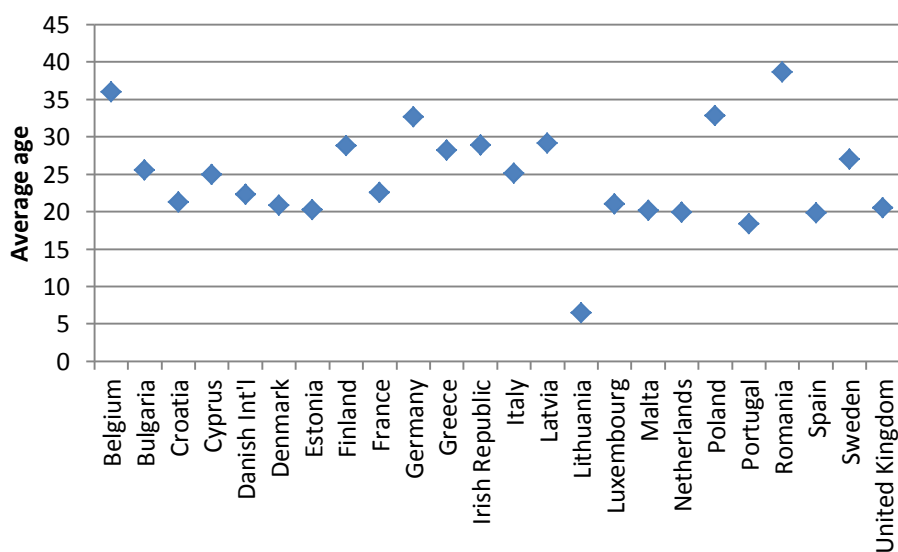


Figure 5: Average age of EU member states fleet  
Source: Clarksons World Fleet Register (2014)

<sup>16</sup> Ferries aged above 50 years and in-service were removed from the analysis

## 5 Methodology

This research uses the framework developed in Rehmatulla (2014) to investigate issues affecting energy efficiency in the ferry sector. The framework compares the perceptions of barriers or issues to observed level of barriers or issues using a mixed methods approach and a specific economic theory, agency theory, which has been helpful in explaining issues around energy efficiency.

The agency theory is directed at the ubiquitous agency relationship, in which one party (the principal) delegates work to another (the agent) who performs that work (Ross 1986, cited by Eisenhardt 1989) or when one individual depends on the action of another (Pratt & Zeckhauser, 1985). The theory aims to resolve two key agency problems that occur as a result of this relationship:

- Problem 1: The desires or the goals of the principal and agent conflict (split incentives problem)
- Problems 2: It is difficult or expensive to verify the agent's actions (informational problem)

### 5.1 Principal agent problems

When agency theory is applied to discuss barriers to energy efficiency, the term principal agent problems is used. Principal agent problem results in several cases that suggest optimal or sub optimal outcomes for investment in energy efficiency. The principal agent problem arises from an agency relationship. The principal agent problem as a barrier in energy efficiency arises in:

“transactions when the entity responsible for making investment decisions is not the party responsible for paying future costs of operation caused by that investment” (Vernon & Meier 2012, p 267).

It has long been recognised that principal agent problems are pervasive in the buildings sector, both residential and commercial rental markets (for which it has been referred to as the landlord-tenant problem) by Blumstein et al. (1980), Jaffe & Stavins (1994), Lovins (1992), Fisher & Rothkopf (1989), IEA (2007) etc. Apart from the rental markets (or operations), it is thought to be impeding energy efficiency at design and construction as well. For example in construction of buildings, builders do not optimise for energy efficiency in order to hold construction costs down (e.g. developers choosing to install electric space heating, even though for tenants this is more expensive than gas) and because their productivity is measured in different scales (Lovins 1992 and IEA 2007). In the rental market, landlords will generally not purchase efficient devices for rental properties since the tenants pay the cost of operating the devices (Jaffe and Stavins 1994; Murtishaw & Sathaye 2006; Maruejols & Young 2011) thus the tenant pays energy costs that are largely determined by the infrastructure present in the building, which is subject to landlord's decision. Similarly, landlords may not maintain the devices well when tenants pay the operating costs (Murtishaw and Sathaye 2006). Generally, the landlord has no incentive to make energy efficient investment as only the tenant directly benefits from these reduced costs, which insulates the landlord from energy price signals. These findings from the buildings sector suggest that principal agent problems in context of energy efficiency could possibly exist in other sectors, where there are similar contractual arrangements. These problems have also been witnessed in the shipping sector (Rehmatulla, 2014) and it is plausible that they may have implications in energy efficiency in the ferries sector.

In some cases though, where markets are efficient this problem may not hold, as a landlord who has invested in energy efficiency of his building should be compensated with higher rent. Thus, the principal agent problem is a function of several different conditions such as the number of contracting entities, length of contracts, apportionment of costs and the level of information. The above however are only related to one type of contract that is prevalent in the rental markets (this classical landlord-tenant relationship is depicted in Figure 6 ), where the tenant (the principal) pays rent to the landlord (agent) in exchange for the use of the building and additionally pays energy costs. According to Meier and Eide (2007) and IEA (2007) up to four different relationships are possible depending between the contract between the parties as shown below in Table 3.

According to the above sources, different questions have been put forward to determine whether the end use is affected by principal agent problem. According to Murtishaw and Sathaye (2006) the following three questions must be answered:

- Who uses the device?
- Who selects the device?
- Who pays the energy cost?

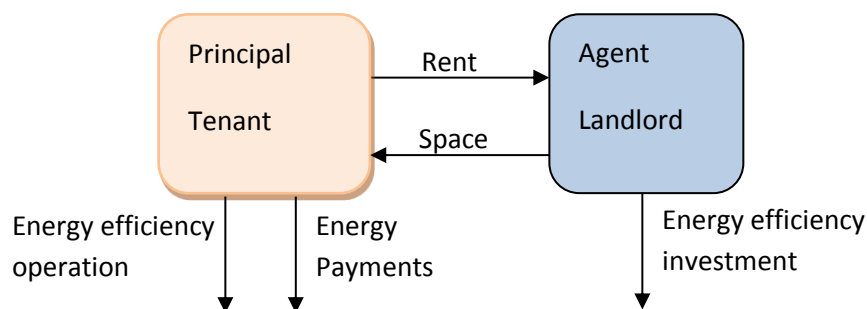


Figure 6: Classical tenant-landlord problem

By categorising who is responsible for energy costs and energy purchases (as shown in Table 3) the principal agent problem can arise from two kinds of split incentives, one concerning usage (demand for energy services) and other concerning the technical efficiency of the end use device (Murtishaw and Sathaye 2006).

	<b>End user can chose technology</b>	<b>End user cannot chose technology</b>
<b>End user pays energy bill</b>	No principal agent problem. Case 1	Efficiency problem. Case 2
<b>End user does not pay energy bill</b>	Usage and efficiency problem. Case 3	Usage problem. Case 4

Table 3: Transactions from an end user perspective

The questions are extended by IEA (2007) and Meier and Eide (2007), to include the following:

- Who selects the energy using technology?



- Who purchases the energy using technology?
- Who pays the energy bill?
- Who owns the energy using technology?
- Who controls operation of the energy-using technology?

In case one, the end user (e.g. dwelling occupant) selects the energy-using technology (e.g. refrigerator, etc.), selects its energy efficiency and pays for its energy consumption, thus the end user will be incentivised to make a reasonable investment in energy efficiency (although this may be affected by other barriers that may be present). In this case it can be said that no principal agent problem exists because the principal and agent are the same entity (IEA 2007) or the principal makes the energy efficiency investment and pays the energy cost. In the context of energy efficiency this is the ideal situation because there are no diverging interests between principal and agent, information is costless, easily transferred, and all costs and benefits of energy efficiency investment are internalised (Vernon and Meier 2012). This situation is illustrated in Figure 7.

In case two, the end user cannot choose the energy using technology or make an energy efficiency investment. Instead, the agent selects the energy-using technology and makes the energy efficiency investment, but the end user, i.e. the principal, pays for the energy use. A principal agent problem can be said to exist here and is defined as an “efficiency problem”, which refers to the forgone energy efficiency investment, referred to in the earlier example of the classical tenant-landlord problem. In this case, as depicted in Figure 8, the market also fails to provide adequate information on energy efficiency to the principal (IEA 2007) resulting in adverse selection by the principal (due to agent’s pre contractual opportunism) or the inability of the agent to recoup the investment in energy efficiency. Other examples of this situation are in the car rentals business, sale and purchase of capital equipment and appliances.

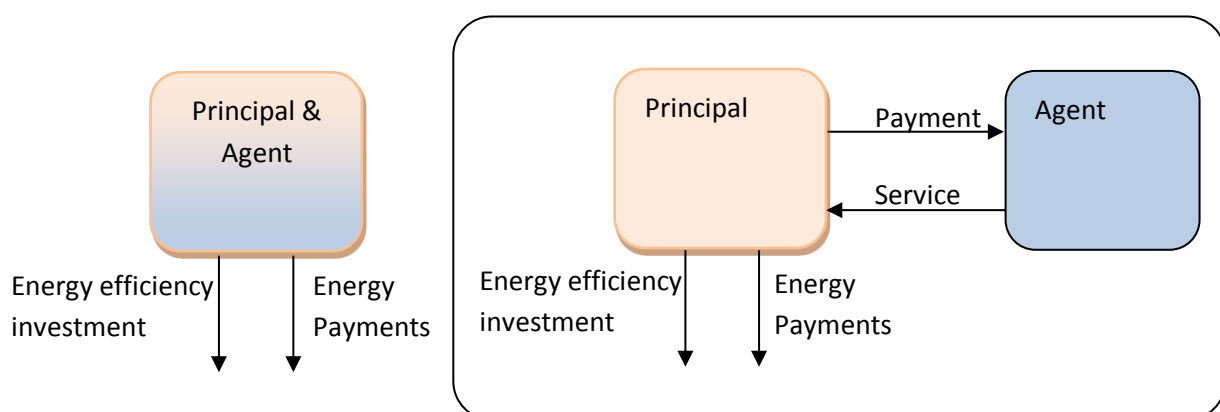


Figure 7: Case one of the principal agent problem

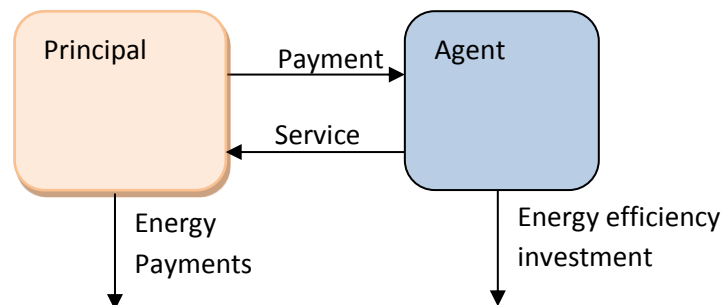


Figure 8: Case two, efficiency problem in principal agent problems

In case four the end user is neither able to select the energy-using technology or make the energy efficiency investment nor pays the energy cost. This is classed as “usage” problem because the end user faces no economic constraint on usage, i.e. the end user consumes more energy than is reasonable (Meier and Aide 2007). Examples of this situation are where energy cost or utilities are included in the overall rental charge, hotel rooms, etc. The principal pays only indirectly for energy use as part of the payment for use of the product or service (IEA 2007). In this case, the agent may try to over-invest in efficiency in order to minimise the consequences of unconstrained usage problem.

The research begins with review of literature that feeds into the principal agent analysis above, resulting in issues identified from secondary research. Thereafter, interviews as a research method are used to cross-examine and validate the findings.

## 6 Issues in ferry procurement processes

This section provides a description of the problem using secondary research and primary research methods. There is a need to first have a good description of the problem, i.e. through descriptive questions that aim to address what is actually going on in the ferry tendering process through secondary desk research. This secondary research and analysis makes use of the principal agent theory, as mentioned in section 3. This section starts by providing an overview of the stakeholders involved in the ferry tendering process, the contracts with which they interact and conceptualises the principal agent problem in order to assess the level of impact of ferry procurement policies on GHG emissions and energy efficiency.

### 6.1 Principle agent analysis

In order to evaluate principal agent problems in the ferry industry, it is first necessary to identify the participating firms and understand the basic types of contracts through which they interact. Thereafter, it is necessary to identify which entity makes capital or equipment purchasing decisions and fuel consumption costs. Systems thinking methods such as the stakeholder mapping tool are used in here to depict the stakeholders within the system. Stakeholder mapping tools are used again to depict the stakeholders within the different types of contracts and business arrangements (types of companies).

#### 6.1.1 Stakeholder analysis

In the ferry industry there are various stakeholders that enable it to function and deliver the transportation service. However, a few stakeholders, as highlighted in Figure 9, have the largest impact on the way that it operates and could potentially affect the sustainability choices during the tendering process. These key stakeholders can be grouped into operators and regulators, and defined as follows:

- **Ferry operator:** Responsible for the direct running of the ferry on a day to day basis. A ferry operator can be a long-term bareboat charterer, private operator, community operator, public operator (government).
- **Ferry owner:** Owns the ferry and is the ultimate controlling owner who benefits from any profits the ship makes (beneficial owner) or can be a company which has commercial control over a vessel's operation without owning the ship (disponent owner).
- **Local authority:** Responsible for local services including infrastructure and procuring ferry services on local routes.
- **Central Government:** Responsible for setting national transport policies and providing ferry services at a national level.
- **Regional transport partnerships:** Responsible for providing ferry services at a regional level.

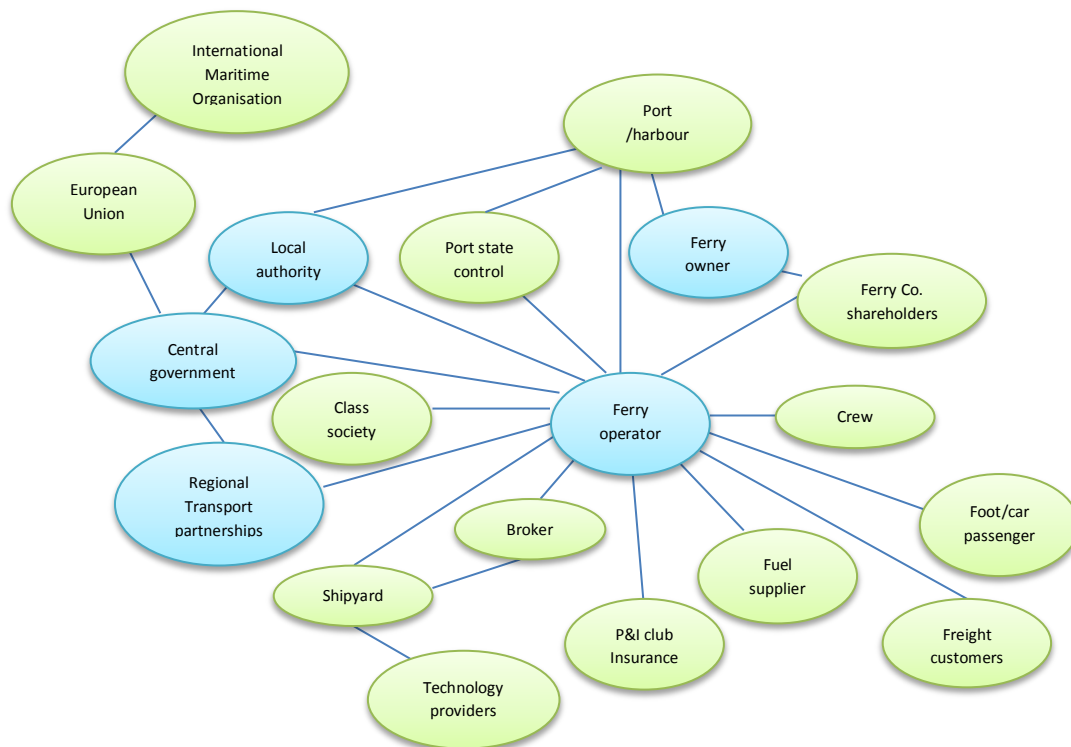


Figure 9: Stakeholders in the ferry industry

### 6.1.2 Overview of different types of ferry service delivery options

There are essentially three ways of delivering ferry services; publicly-owned operators, e.g. Caledonian MacBrayne, privately-owned operators, e.g. Rederij Doeksen, and community-owned operators, e.g. TESO. Each delivery option gives rise to varying responsibility over costs and risks for each stakeholder, as shown in Table 4.

<p><b>Capital costs</b></p>	<ul style="list-style-type: none"> <li>• New-building or second-hand purchase</li> <li>• Debt repayment</li> <li>• Interest</li> <li>• Retrofit</li> <li>• Harbour infrastructure</li> </ul>
<p><b>Operating costs</b></p>	<ul style="list-style-type: none"> <li>• Voyage costs – fuel, port dues, canal dues</li> <li>• Operating costs – crewing, repair, dry-docking, maintenance, surveys, insurance</li> <li>• Vessel charter costs</li> <li>• Insurance</li> <li>• Shore costs - Property rental, shore staff wages, insurance, corporate overheads</li> </ul>

Table 4: Capital and operating costs in delivering ferry services

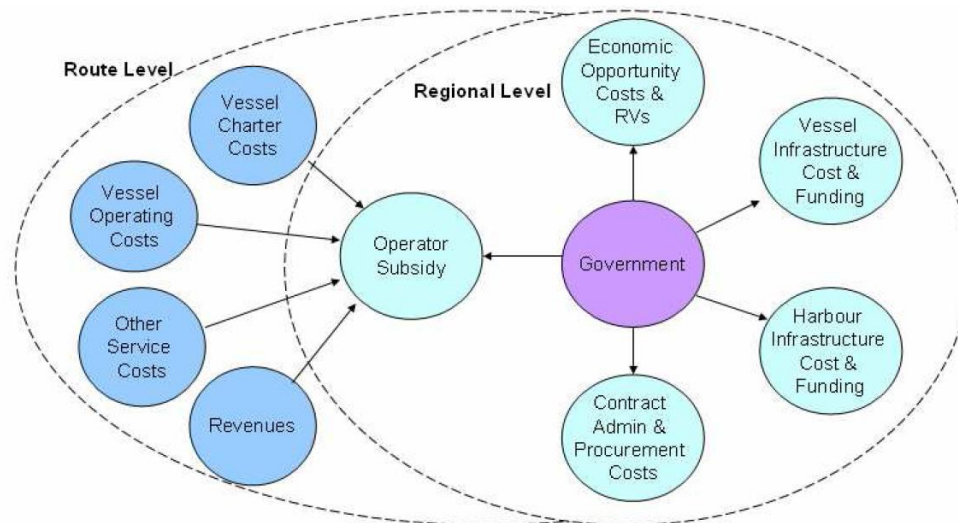


Figure 10: Costs from a government and operator perspective  
Source: Grant Thornton (2010)

Besides the three ways of delivery of ferry services, the vessels themselves can be delivered using two forms of charter, the time or period charter and the bareboat charter, adding further complexity to the allocation of costs in ferry operations. In a time charter, a charterer contracts with an owner-operator for the use of a crewed vessel for a certain period of time, which may be for a single trip (trip charter) or certain length of time (period charter). This contract is similar to hiring a car from a rental company (but with the difference that the driver is also included in the hire). A time charterer gains the operational control of the ships carrying its cargo, while leaving the ownership and management of the ship for the ship-owner. As shown in Table 5 under a time charter, the ship's capital expenditure and some operational control is done by the ship-owner (e.g. providing crew and master) but the fuel cost is paid by the charterer in addition to the charter day rate. In ferry operations a time charter is entered into when additional sailings are required or when demand is high (daily or seasonal). This charter reflects case two as described in 5.1 and can be said to be resulting in principal agent efficiency problem.

A bareboat charter involves the use of a vessel in which the capital expenditure is accrued by the bareboat owner and all other costs are borne by the bareboat charterer, as shown in Table 5, similar to a long lease in the property market. Unlike in commercial property, the hire charge for the vessel is on a per day basis rather than an upfront lump sum. The bareboat charterer obtains possession and full control of the vessel along with the legal and financial responsibility for it. Where the ferry owner and the ferry operator are a single entity, there can be said to be no principal agent problems existing. However there will be other principal agent problems that may be faced as will be discussed below.

	Time charter	Bareboat charter
<b>Voyage Expenses</b>	<b>Operator</b>	
Fuel		
Port dues		
Canal dues		
<b>Operating expense</b>		
Crewing		
Maintenance		
Repairs		
Surveys		
Insurance	<b>Owner</b>	
management		
<b>Capital costs</b>		
Purchase cost		
Interest		
Retrofit		
Dividends		
Debt repayment		

Table 5: Cost allocation in time and bareboat charter

### 6.1.3 Description of principal agent problems

In the principal agent relationship, the private ferry operator can be described as the agent and the appropriate government level authority as the principal wishing to obtain the ferry service. The government level authorities are in turn agents for the general public. This creates a chain of principals and agents in the delivery of the ferry services, as shown in Figure 11, where, given some of the costs and responsibilities mentioned above, each relationship may impose adverse incentives towards the energy efficiency of the ferry, discussed in the following sections.

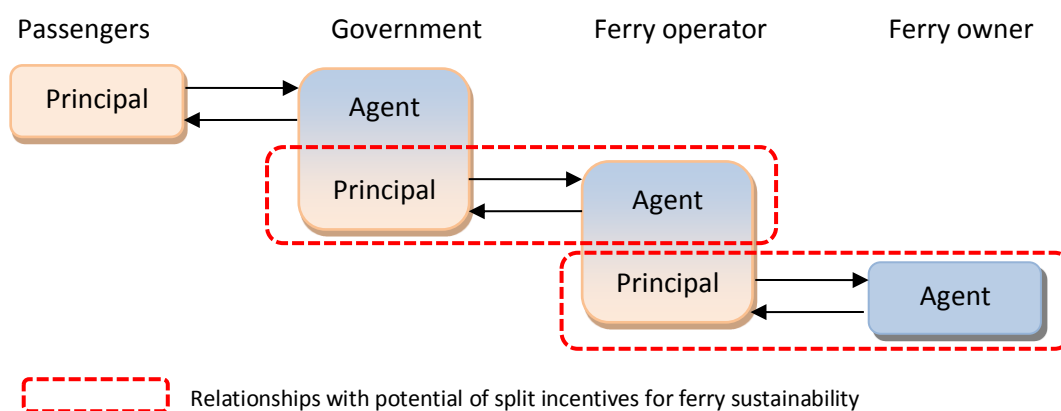


Figure 11: Principal agent relationships in ferry operations

### 6.1.4 Split incentives due to divided cost responsibility and risk

The key issue arises as a result of the costs being split between the ownership and operation of the vessel, where the operator bears the operating costs (including fuel cost) and the owner bears the capital costs. This represents case two of the principal agent problem, as shown in Figure 12, resulting in efficiency problems as the charterer cannot select the energy efficiency technology but pays for the fuel as a result of the investment decision made by the ferry owner, similar to the tenant-landlord scenario discussed in 5.1. This could result in a split incentive efficiency problem, because the principal (i.e. ferry charterer or operator) would prefer to have an efficient technology or ship that results in lower fuel costs, but their agent the ferry owner is not incentivised because they are concerned with initial costs (capital) and not the resultant energy costs. In most cases the contracts between the entities in this case are signed after construction (and many years after), therefore the principal has little influence over the design, for example when a new ferry operator has to take over existing vessels.

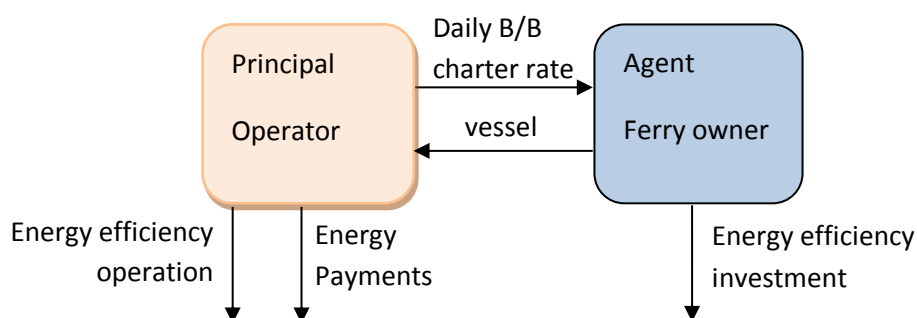


Figure 12: Case two in ferry operations

The split between ownership of the vessel and its operator is further exacerbated due to the three delivery options and the different types of subsidies that are unique to the provision of ferry services. Whether the service is delivered by a publicly-operated, privately-operated or community-operated entity determines who owns the stake in the operation of the service. However this does not govern the provision and ownership of vessels, which can be based on either the operate-only contracts or provide-and-operate contracts. For example, a privately-owned operator could be contracted via a PSC to provide and operate on a specific route, therefore the provision of the service and ownership rests within a single entity, as shown in

Figure 13. On the other hand, a privately-owned operator could be contracted via a PSC to operate on a specific route and the provision of the vessel is from a third party, e.g. the outgoing incumbent operator but usually the Government or public body, hence the provision of the service is separated from the ownership of the vessel, as shown in Figure 12 above.

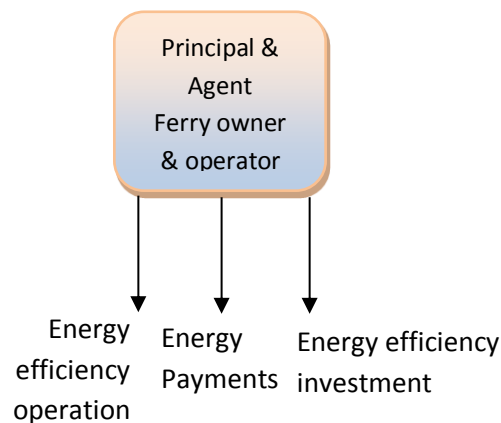


Figure 13: Case one, ferry owner and operator as one entity

### 6.1.5 Influence of operate-only and provide-and-operate contracts on energy efficiency

Whether the tendered contract should be for operation only (i.e. vessels owned by state) or for provision and operation of vessels by operators poses a key issue in sustainable tendering (promoting energy efficiency) for ferry services. The pros and cons of each contract and its implication on energy efficiency are discussed below.

Operate-only contract (i.e. government or public body owns or provides the vessel) has the following benefits and drawbacks (respectively) on energy efficiency of the vessels:

- Vessels can be written down over their economic life (around 25 years), rather than over the duration of the PSC (generally six years). Owning a vessel for its economic life would make it attractive for investment in energy efficiency technology as the payback for these generally ranges from a couple of years to ten years.
- There is certainty for the public body that a vessel will be on a particular route for its economic life and as a result the investment in the port and harbour infrastructure (generally in public ownership) can also be economically viable. The ship-port configuration leads to further efficiency gains, as ships save fuel on manoeuvring, etc.
- The tendering process can attract competition for routes by minimising the barriers to entry for new operators, who would be incentivised to create efficiency through operations.
- Vessels used in the delivery of the ferry services may be well maintained (e.g. appropriate hull coating and hull cleaning regime, due to the long-term vested interest in the vessel. These maintenance measures can save a significant amount of the fuel consumed and thereby reducing GHG emissions.

The drawbacks of operate-only contracts are:



- Bidding firms may be prevented from offering vessels which may be more energy efficient, instead having to accept existing vessels which may not be most efficient, which in turn will affect the bidding as increased fuel costs need to be taken into account.
- Central government or the public body has to find the capital to procure newer vessels and under existing circumstances this is a challenging task. This affects the fleet turnover and as a result very old ships (average age of thirty years) continue to operate on EU waters. The age of the ship has been shown to have a negative correlation with fuel or energy efficiency.
- Operating vessels built almost thirty years ago for meeting current market demands (e.g. changes in pax-car ratio and general increase in demand) leads to operational inefficiencies as ferries have to increase speed (supply) to meet increased demand. Another example where design considerations have an impact on the operational efficiency is the passenger to vehicle ratio, where vehicle deck capacity tends to reach full capacity well before passenger capacity as a result of over estimating foot passengers (Baird, Wilmsmeier, & Boglev, Scottish Ferries Review, Part A: Methods of ferry delivery and operation, competition and procurement, and environmental issues, 2010). This in turn determines the crewing level required, which account for large proportion of operating costs.
- Current tendering practices, both net cost and gross cost subsidy contracts do not reward operators for in-contract efficiencies as the cost of fuel or energy efficiency is eventually passed through (however tendering does reward energy efficiency *ex ante* by awarding the contract to the lowest bids, which can be as a result of cost savings in fuel efficiency or by awarding the contract to the MEAT bids, which reveal quality through better energy efficiency).

Provide-and-operate contract (i.e. operators owns or provides the vessel) has the following benefits and drawbacks on energy efficiency of the vessels:

- The capital investment (capex) in building or buying vessels is borne by the operator, who is thought to be able to attract various borrowing facilities and thus freeing the government from finding the capital. Because the operator is responsible for both, the capex and opex (operational expenditure including fuel), their view on relationship between the two cost items (e.g. higher investment in energy efficiency technology with a lower energy bill) may be different than when it is split among two different entities. Therefore innovations regarding the design and operation of the vessel may appear more readily when vessel ownership is left to the operators.
- Thus operators can select vessels which they consider optimal for each given route, providing in their view the most effective, efficient, and economic rather than accepting existing vessels specified and provided by the state or state-owned entities.
- Each subsequent tender offers the opportunity to introduce newer and improved vessels, and this may be attractive if energy efficiency technology has advanced over the period.

The drawbacks of provide-and-operate contracts are:

- Owner-operators have to recover their investment costs over a limited contract duration and may therefore want to depreciate their vessels over much shorter horizon. This impacts on their

decision to further invest in energy efficient ships which cost more and may therefore impede on the payback period for the investment, although the higher investment or capex may be recouped through savings operation in the operation.

- Since the ports and harbour infrastructure are generally in the ownership of the public body, an investment in energy efficiency needs to ensure that it fits in with the current system or infrastructure e.g. pontoon interaction with the vessel, mooring (auto mooring) capability, double open-ended ferries, etc. This results in ratchet effects (irreversible and stranded assets) as some port facilities require specifically designed ferries making investments in ferries idiosyncratic, which may act as a barriers to entry for outside firms to participate in the tender.
- The tendering of routes and the actual provision of the service may create uncertainty and insecurity for the bidding operator due to the lead time required to build the vessels, usually two years. This means that the provide-and-operate contract needs to be in place in the previous contract and consequently the contract may be re-tendered in the current contract.
- If the bids are assessed on lowest cost criteria and if there is significant cost pass through e.g. bunker fuel surcharges, then there may incentives to use older and inefficient vessels.
- The provision of vessels by operators may suppress competition by creating a barrier to market entry for new operators.

### 6.1.6 Influence of gross cost and net cost contracts on energy efficiency

The operating cost risk is generally the operator's risk (e.g. rising maintenance costs and fuel costs) and the capital cost risk (purchasing and replacement) may be for the operator, in the provide-and-operate contract or for the contracting authority in the operate-only contract. Furthermore, revenue risk (low demand) can also be transferred to the operator in a net cost contract or retained by the authority in a gross cost contract, potentially leading to lack of incentives to enhance the demand and consequently revenue but at the same time resulting in lower bids due to lower perceived risk by the operator. To some extent, some risks borne by the operator on net cost contracts can be transferred to the end-users or passenger, e.g. bunker price increases added as fuel surcharges on fares. When fuel costs increase the ferry operator must either increase the fares or increase the fuel efficiency to maintain a constant profit margin, although the immediate and short-term response may be to pass on the fuel costs in the form of fuel surcharges (Faber, et al., 2009). The ability to pass on costs is dependent on the elasticity of the fares to bunker price, which is in turn dependent on the price elasticity of demand which in ferry services in some examples has been shown to be rather low (-0.3 to -0.4) causing weak incentives for cost efficiency for the operator (Brathen, Hervik, Odeck, & Sunde, 2004). Table 6 shows the split of risks in a provide-and-operate and operate-only contract for the different entities and Table A1 below shows an example of the split in responsibilities in a call for tenders in the context of Scottish ferry services. Table 7 outlines the risks appropriated by stakeholders in context of the different delivery services and in of construction of new vessels in three states.

<b>Provide-and-operate contract on a net cost contract</b>	<b>Operate-only contract on a net cost contract</b>
<p>Authority is responsible for:</p> <ul style="list-style-type: none"> <li>• Setting the fares for the service</li> <li>• Making bye-laws in relation to its operation</li> <li>• Running discounted fares scheme</li> <li>• Sets service requirements i.e. developed the output specification including timetable and performance standards;</li> </ul>	<p>Government is responsible for:</p> <ul style="list-style-type: none"> <li>• Setting policy</li> <li>• Procuring operators</li> <li>• Sets service requirements i.e. developed the output specification including timetable and performance standards</li> <li>• Directing the use of owned vessels</li> <li>• Providing funding for new vessel investment.</li> </ul>
<p>Operator is responsible for:</p> <ul style="list-style-type: none"> <li>• Provision and maintenance of the vessels</li> <li>• Day to day operation of the service</li> <li>• Marketing of the route</li> <li>• Collection of fares</li> </ul>	<p>Operator is responsible for:</p> <ul style="list-style-type: none"> <li>• Day to day operation of the service</li> <li>• Marketing and revenue generation</li> <li>• Collection of fares.</li> </ul>
	<p>Vessel owning authority:</p> <ul style="list-style-type: none"> <li>• Ownership, maintenance and replacement as necessary of the fleet of vessels;</li> <li>• Ownership, management and maintenance of piers, harbours, buildings and associated infrastructure;</li> <li>• Ownership, safeguarding and 'licensing' of the brands and other registered trademarks.</li> </ul>

Table 6: Split of risks in a provide-and-operate and operate-only contract

Risk	Ireland	Northern Ireland	Scotland
Construction cost risk	Operator	Operator	Scottish Government
Design risk	Operator	Operator	Scottish Government
Specification risk	Operator	Operator	Scottish Government
Performance risk	Operator	Operator	Operator
Maintenance risk	Operator	Operator	Operator
Vessel demand risk	Operator	Operator	Scottish Government
Residual value risk	Operator	Scottish Government <sup>17</sup> & operator	Scottish Government

Table 7: Risks appropriated by stakeholders in context of different delivery services in three states  
Source: Grant Thornton (2010)

### 6.1.7 Influence of delivery options on energy efficiency

The incentives of the publicly-owned, privately-owned and community-owned operators to a large extent are dependent on whether they provide the vessels or only operate the vessels as discussed above. The key differences between the delivery options generally centre around access to capital or lack of finance, which has a direct influence on the renewal of the EU ferry fleet and therefore the energy efficiency of the vessels. Although publicly-owned operators maintain they are able to raise capital for new-builds at no disadvantage compared with private operators (Baird, Wilmsmeier, & Boglev, Scottish Ferries Review, Part A: Methods of ferry delivery and operation, competition and procurement, and environmental issues, 2010) their analysis shows that only 10 - 20% of the new ferry orders in 2010 were for the account of publicly-owned operators, suggesting private operators have been more successful in raising capital and bringing in newer vessels. Comparison of the Scottish ferry companies<sup>18</sup> and other major European private companies, publicly-owned and operated and privately-owned and operated presented in Table 8 and Figure 14, shows that the average fleet age of privately-owned operators is circa seventeen years compared to publicly-owned operators with an average age of twenty one years.

<sup>17</sup> Rathlin Island Ferry Ltd (RIFL) uses the ferry (MV Canna) leased as a bareboat charter from Caledonian Macbrayne Assets Limited (CMAL) and RIFL (private operator) also owns a pax only ferry in operation in N. Ireland.

<sup>18</sup> The Scottish context is ideal because of the data availability from the Scottish Government on public and private operators as well as representing a high proportion of publicly owned and operated ferry companies e.g. councils

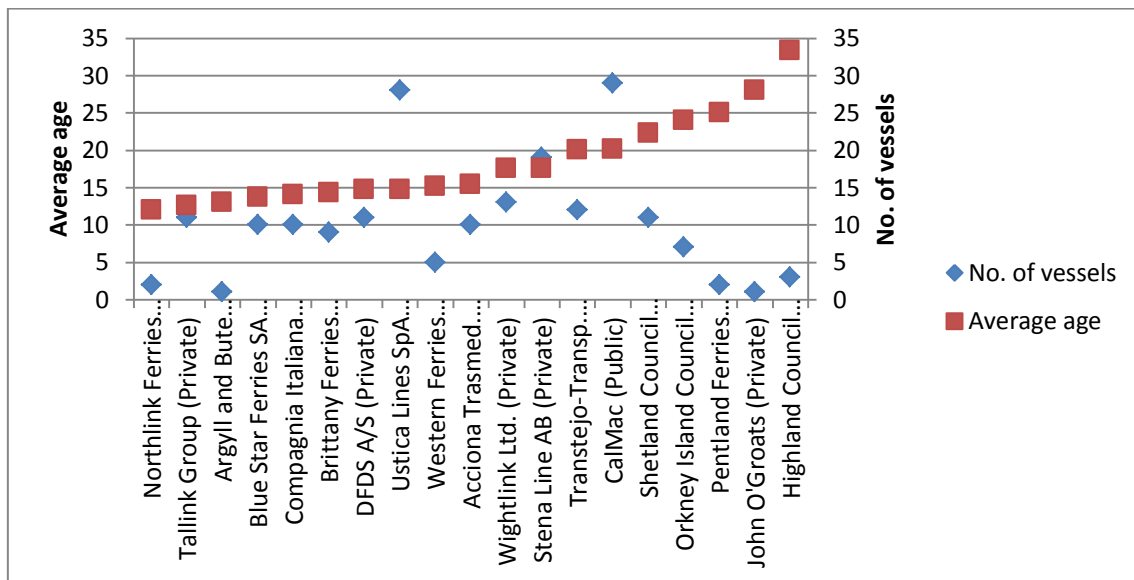


Figure 14: Average age of vessels owned by public and major private operators

Company	Headquarters location	No. of vessels	Average age	Ownership
Tallink Group	EU	11	13	Private
Blue Star Ferries SA	Greece	10	14	Private
Compagnia Italiana	Italy	10	14	Private
Brittany Ferries	France	9	14	Private
DFDS A/S	Denmark	11	15	Private
Ustica Lines SpA	Italy	28	15	Private
Acciona Trasmad.	Spain	10	15	Private
Wightlink Ltd.	UK	13	18	Private
Stena Line AB	EU	19	18	Private
Transtejo-Transp.	Portugal	12	20	Private
Western Ferries	Scotland, UK	5	15	Private (unsubsidised)
Pentland Ferries	Scotland, UK	2	25	Private (unsubsidised)
John O'Groats	Scotland, UK	1	28	Private (unsubsidised)
CalMac	Scotland, UK	29	20	Public
Northlink Ferries	Scotland, UK	2	12	Public
Orkney Island Council Ferries	Scotland, UK	7	24	Public
Shetland Council Ferries	Scotland, UK	11	22	Public
Highland Council	Scotland, UK	3	33	Public
Argyll and Bute Council	Scotland, UK	1	13	Public

Table 8: Average age of vessels owned by public and private companies

### 6.1.8 Split incentives due to inability to recoup investments affecting sustainable choices

Section 6.1.3 above highlights the disconnect between capital and operational costs under various forms of charter, provide-and-operate and operate-only contracts and the delivery options. Central to the split in costs in the aforementioned is the ability of the investing entity to recoup investment in energy efficiency. This is primarily a problem in the ferry bareboat charter that is generally used in the operate-only contracts. The incentives could be realigned if the investment by the agent, i.e. the ferry owner, in energy efficiency could be directly reflected through a higher charter rate charged by the agent to the principal who would save on the fuel costs. Thus, the adoption of energy efficiency technologies will most likely occur if the adopter can recover the investment from the party that enjoys the energy savings. The extent to which the fuel cost savings are passed back to the owner through a higher charter rate, i.e. the ability to recoup the investment, has not been investigated thoroughly in ferry operations and in shipping. There is difference of opinion in the literature on whether investment in energy efficiency is recouped at all and regarding the level of recoupment if any. Agnolucci, Smith & Rehmatulla (2014) show that on average 50% of the investment in energy efficiency can be recouped in the drybulk Panamax sector, i.e. for every pound of investment in energy efficiency the shipowner receives only half the amount through higher charter rates.

The inability to recoup the investment could in part be due to informational problems or information asymmetry meaning that a charterer is not fully able to assess the actual (technical and operational) efficiency of the ship and thus not willing to pay a higher rate to reflect this prior to signing the contract. This in turn could be because the ferry owner is not able to portray the energy efficiency of the ship (i.e. lacks information due to lack of monitoring) to be able to reflect the charter rate.

In the situation where there is an operate-only contract and the vessel is provided by the state (or relevant authority), the key questions then are:

- How much can the government agency recoup, if new energy efficient vessel is provided, through higher bareboat charter rate (i.e. premium), and
- How does this affect the operator's costs (since a newer and efficient ship will benefit from fuel and maintenance efficiencies) and therefore subsidies. That is, do newer and efficient ships owned and managed by government result in lower subsidies?

### 6.1.9 Split incentives due to tendering durations affecting sustainable choices

The EU regulations do not set a maximum duration for PSCs but does provide that they should be of a limited duration in order to allow regular and open competition in the market. The guidance issued by the EC on the duration of tendering periods or concession length is six years. Currently, however the EC preferred duration is not reflected in practice, as shown in Table 9. In some instances, contracts for subsidised ferry services are as short as one year (e.g. Greece) and as long as a decade (e.g. Italy).

The mismatch of the ‘preferred’ or limited concession lengths and vessel life (circa 25 years) may impact the operator’s ability to procure newer or invest in energy efficient vessels and finance them over the contract period. There is inconclusive evidence on whether the preferred concession length discourages potential operators from procuring new and energy efficient vessels. Grant Thornton (2010) suggests that there is evidence to support this argument from previous tendering exercises in Northern Ireland and Ireland. On the other hand (Baird, Wilmsmeier, & Boglev, Scottish Ferries Review, Part A: Methods of ferry delivery and operation, competition and procurement, and environmental issues, 2010) suggest that EU case studies carried out as part of the review suggest that the tendering period is not necessarily as significant a constraint as might be thought in terms of the provision of new ships being brought in by bidders. In Norway, Sweden and Denmark new ships have been introduced by operators as part of six year contracts. Moreover, the review provides some evidence that suggests that new ships provided in the first round of tenders continue to be used in the subsequent rounds.

Therefore, the view that bidders providing vessels on six year contracts would have to fully amortise their investment over the period, may not hold. It is suggested (Baird, Wilmsmeier, & Boglev, Scottish Ferries Review, Part A: Methods of ferry delivery and operation, competition and procurement, and environmental issues, 2010) that this is reflective of current practice as amortisation over a six year period leads to considerable costs in the calculation of the compensation or subsidy and, therefore, not competitive on cost terms. Thus, some operators with a long-term view will seek to pitch a lower bid by depreciating over the lifetime of the vessel in the hope of winning subsequent rounds as well, as suggested by operators’ comments in the review.

The limited tendering duration argument is closely linked to the pros and cons of provide-and-operate and operate-only contracts, discussed in section 6.1.5. On the one hand, a centralised state ship-owning company could invest in newer and efficient ships and facilitate the transfer of ships to subsequent operate-only operators at the end of each contract, on the other hand if the investment is not taking place than it may counteract the benefits of provide-and-operate contracts, where operators may propose to use more efficient ships.

The tendering process that is open to alternative ship solutions generally does not reflect the sunk costs and additional risk that may be taken by the investing entity. Thus a company may invest in a vessel which wins it an initial contract but in the subsequent tenders it is found that offers submitted by other bidders proposing alternative lower cost ship solutions are more cost competitive. Current practice to avoid stranded assets and to better reflect the sunk costs in assets is to state that the ship is ‘so specific’ that it has to be used for subsequent contract periods; thus no bidder is able to propose an alternative lower cost option (Baird, Wilmsmeier, & Boglev, Scottish Ferries Review, Part A: Methods of ferry delivery and operation, competition and procurement, and environmental issues, 2010).



Country	Duration (years, average or range)
Denmark	5
Estonia	5 & 10
Finland	2 - 5
France	5 - 7
Greece	1 -12
Italy	20
Ireland	1 – 5
Malta	6
Portugal	2
Spain	5
Sweden	4 + 2
UK	2 + 1, 6
Iceland	3 – 6

Table 9: Approximate durations of tender periods in various EU countries  
Source: Baird, Wilmsmeier & Boglev (2010)

### 6.1.10 Split incentives due to public service obligations contract

PSOs or PSCs are required to guarantee a minimum level of service to a particular community when such services might not be commercially viable. Some operators suggest that commercial viability depends on how a service is provided (as governed by the PSO or PSC) (Baird, Wilmsmeier, & Boglev, Scottish Ferries Review, Part A: Methods of ferry delivery and operation, competition and procurement, and environmental issues, 2010), thus operators may be able to operate without subsidies in some instances if they have the freedom to operate as they choose, rather than operate to a prescriptive service specification.

Some of the funding models used to compensate ferry operators through subsidies may not provide incentives to the operator to operate efficiently and therefore energy efficiency may not be effectively rewarded. Examples of these are subsidies which include a graduated clawback mechanism to conform with EU rules in respect of maritime PSOs. Although the operators are expected to make a ‘reasonable financial return’, any resulting profit or financial return over and above a certain amount is usually clawed back, disincentivising profit maximisation objectives of privately-owned operators. On the other hand, an operator that does not make a profit is fully subsidised and therefore cushioned against such a loss. Thus the graduated clawback mechanism creates perverse incentives for the operators.



Baird, Wilmsmeier & Boglev (2010) suggest that to create sufficient incentives for the operator, especially in the Scottish context where the clawback is generally used, the clawback could be limited to 50%, instead of the current practice of 95%, thereby giving the operator more incentives to maximise profit, which could come about as a result of increased revenue, e.g. from additional traffic, or as a result of cost control, e.g. from energy efficient investment and operations. Furthermore, in some circumstances perverse incentives can be seen when a subsidised operator and a non-subsidised operator operate on similar routes. The private operators with a profit maximising goal (can generate additional revenue through additional traffic) may lead to equivalent increase in the subsidy of the subsidised operator (who loses out on the traffic to the private operator). However, in most cases investigated by Baird, Wilmsmeier & Boglev (2010) contracting authorities do not impose profit clawback mechanisms on operators. Once the service arrangements are agreed, including maximum prices, there seems no need to constrain profits and hence to reduce incentives for operators to make profit through further service enhancements, new market development, etc. This is another example of lack of standardised application of EU policy on the subject of ferry procurement by member states in their PSOs and PSCs which could potentially be affecting investment in energy efficiency as a measure to reduce costs and improve profits.

### **6.1.11 Split incentives due to multiple principal agent relationships (longer chain)**

As highlighted in section 6.1.2, there are various forms of delivering ferry services. Each of these can contain multiple relationships instead of the one principal and one agent scenarios described above. The implication of this is that energy efficiency may not be a priority for different entities in the chain as a result of different cost responsibilities, energy price shielding and other constraints. An example of this is the trade-off between sailing time and operational energy efficiency that could be achieved from slower crossings. Based on the rule of thumb, a 10% reduction in speed results in nearly 30% reduction of power requirements, thus speed reduction is considered to have one of the highest impact on energy efficiency (Smith, Parker & Rehmatulla, 2011). In ferries it is estimated that in a large ROPAX ferry a reduction of 0.5 knots would result in 20% reduction in CO<sub>2</sub> emissions whilst only adding five minutes to a two hour journey (Scottish Government, 2011).

One of the costs passengers bear is the value of their time, the reduction in travel time made possible by faster ferries significantly reduces passengers' total cost. Thus, if slower crossings are introduced or proposed in order to improve operational energy efficiency, then other aspects of the ferry services may be at risk, e.g. revenue. On the other hand a reduction in speed may reduce the fares but the extent to which this will be reflected will depend on the transparency of fuel surcharges and cost pass through. Baird, Wilmsmeier & Boglev (2010) and Scottish Government (2011) showed that operators and passengers in general would not support reduction in vessel speeds as a means for improving energy efficiency and reducing emissions. Therefore the current fare systems across all the EU countries could have failed to take into account the external costs relating to the environment, therefore foregoing options that might be cost-effective from a social perspective but not from a private perspective.

In specific contexts such as the Greek ferry market which has witnessed a high fleet turnover, newer ships are twice as fast as the ships they replaced and as a result travel times have almost been halved in some routes, e.g. Piraeus to Chania reduced to just over five hours from ten hours. Similarly in Gotland where newer vessels with lower speeds were proposed, the stakeholders (islanders and island businesses) suggested that it may put at risk development of tourism and local businesses, therefore faster crossings must be considered of high value in the bidding process. This very clearly highlights the fine balance that is required in environmental policies to mitigate global impacts (e.g. GHG emissions) versus local impacts (e.g. SO<sub>x</sub> and NO<sub>x</sub>).

Another important aspect of the multiple principal agent relationships in the tendering process is the split of responsibilities and costs in different public organisations in terms of managing the tender process, service delivery, operations including harbour services. Currently there is no consistency in the responsibility of managing the whole spectrum of the ferry services. In some EU countries responsibility is split between the central government, local authorities and regional transport partnerships (e.g. Scotland) compared to some countries where the responsibility lies with only one public body such as the central government (e.g. Greece). Where there may exist several public authorities in managing the delivery of ferry services, it is likely that it will give rise to split incentives as different authorities will bear different costs and in their efforts to reduce the costs allocated to them, and may therefore forego the benefits that would have accrued if it were just one entity. This can be witnessed in the jurisdictions which have adopted the operate-only contracts, where the operator is generally not the entity responsible for vessels and has little control over the harbours and port infrastructure. On the subject of harbours and port infrastructure, there can be various configurations that lead to multiple principal agent relationships. In some cases the central government delegates the ownership of harbours and ports to councils or local authorities who then delegate the operation to a contractor, which may or may not be the operator of the ferry service, as shown in Figure 15. The effect of this longer chain of relationship in the context of energy efficiency is that:

- There may be a disconnect in the optimal ferry design to match the port and harbour infrastructure
- The infrastructure could give rise to inefficient ferry operations, e.g. a lack of pontoons may increase waiting times for ferry berthing and therefore increase fuel consumption
- The ports and harbour infrastructure maintenance or lack of maintenance could result in poor operational efficiency, e.g. dredging.

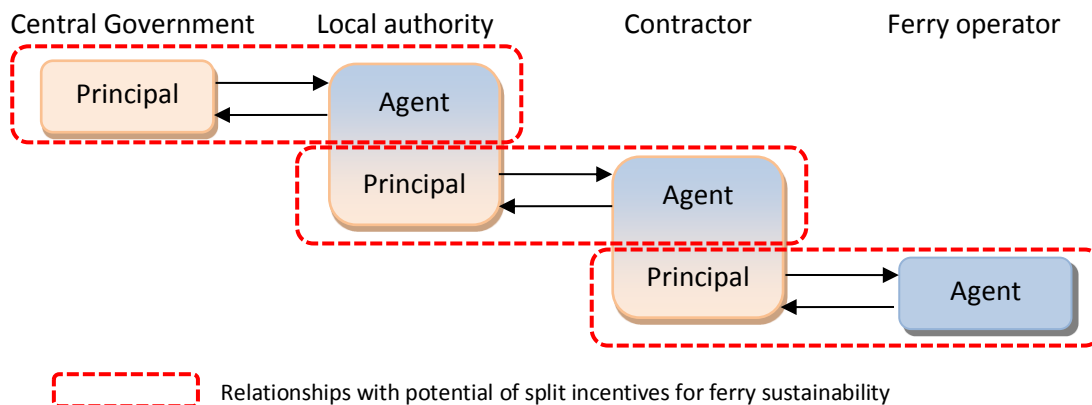


Figure 15: Multiple principal agent relationships in the context of ports and harbours

## 6.2 Other barriers that may be hindering sustainable choices in ferry procurement

Apart from the split incentives arising from principal agent relationships (as discussed in 6.1) there could also be other factors that contribute to the slow diffusion and adoption of energy efficient measures. These factors are referred to as non-market failures and include; heterogeneity, risk, hidden costs and access to capital, all viable propositions in the context of ferry procurement.

Restricted access to capital markets is often considered to be an important barrier to investing in energy efficiency. Investments in energy efficiency may not be profitable because companies also face a high price for capital. As a result, only investments yielding an expected return that exceeds this (high) hurdle rate will be realised (Schleich & Grubber, 2008). Capital rationing is often used within firms as an allocation means for investments leading to hurdle rates that are much higher than the cost of capital, especially for small projects. This leads to competition between projects within a company and may lead to low priority given to energy efficiency (Bhattacharyya, 2011). If improving energy efficiency comes at the cost of forgoing other more cost-effective opportunities (because of capital or labour constraints or because the projects are mutually exclusive alternatives), it would be rational for the firm to give energy efficiency a low priority (Faber, et al., 2009). As an example, a ferry owner-operator currently has to decide between investing in a scrubber technology given the regulations around SO<sub>x</sub> and NO<sub>x</sub> emissions or improve the energy efficiency of ships given the increasing fuel price.

Where the central government or other public bodies provide vessels, it may be difficult to provide energy efficient ferries from existing or traditional sources of funding amidst difficult ongoing budget cutbacks. Furthermore, more investment may also be required from the public authorities to improve ports and harbours, further constraining the investment budgets. As an example, the Scottish Government in its review (Baird, Wilmsmeier, & Boglev, Scottish Ferries Review, Part A:

Methods of ferry delivery and operation, competition and procurement, and environmental issues, 2010) estimated that there is a need for around £1 billion to fund investment in new ships and upgrading piers and harbours, in addition to the £120 – 130 million per annum in subsidies.

Another factor affecting the procurement of efficient ferry services is related to the perception of costs. The following costs may impede on the decision on whether or not to invest in energy efficient ferries or retrofits:

*Life cycle costs* - Costs relating to the energy efficient option's life cycle costs including: identification or search costs, project appraisal costs, commissioning costs, disruption or opportunity costs and additional/specific engineering costs.

*Transactional costs* – Transaction costs and other unobserved cost items may render apparently cost-effective measures costly. Especially, smaller ferry owner-operators may experience high transaction costs as they cannot spread the costs of, for example, gathering information over a large number of ships (Faber, et al., 2009). The transactional costs are additional to the costs of tendering which on their own have been described as very high (Baird, Wilmsmeier, & Boglev, Scottish Ferries Review, Part A: Methods of ferry delivery and operation, competition and procurement, and environmental issues, 2010), to the extent that it is considered to be a disincentive to private operators who have to bear the costs themselves. Furthermore (Baird, Wilmsmeier, & Boglev, Scottish Ferries Review, Part A: Methods of ferry delivery and operation, competition and procurement, and environmental issues, 2010) shows that gross-cost term contracts have higher transaction costs.

*Commissioning or disruption costs* - Some measures to reduce emissions require retrofits that can only be installed by temporarily suspending operations. These measures are very costly to implement except at times when the ferry may be off-service e.g. on dry-dock, such as major maintenance of installations. There may therefore be a lag between the time when a measure becomes available and its actual implementation. Retrofits to existing ferries such as the installation of wind or solar power, waste heat recovery systems etc. can only be done cost-effectively when a ferry undergoes a major overhaul during a dry-dock. This causes a time-lag of several years in the implementation of cost-effective measures.

Further to the above, there may be certain risks such as regulatory, technological and market related risks that could potentially impede sustainability choices in delivering sustainable and efficient ferry services. An example of regulatory risk combined with technological risk is the current ECA rules and the inherent uncertainty associated with the measures to meet these requirements, e.g. uncertainty in the price of LSFO (or HFO) and scrubber technology developments. In the context of ferry tendering there are several market related risks stemming from supply and demand. It is more than likely that any operating subsidies are based on expectation of future demand/patronage, which can be directly linked to the ferry policy of the relevant authority, e.g. Road Equivalent Tariff (RET). The

inherent uncertainty of future demand may disincentivise investment in energy efficiency as it directly affects the revenue streams or future cash-flows to enable payback of the energy efficient ferry or energy efficient measure. On the supply side, the procurement of second-hand energy efficient ferries could be potentially affected by the illiquid nature of the second-hand sale and purchase market and the opaque nature of the charter market due to non-transferrable and purpose built vessels.

In summary, the principal agent analysis suggests various problems that potentially affect the decisions of the stakeholders or entities responsible to make sustainable and energy efficient choices when delivering ferry services. Table 10 below is a summary of the foregoing analysis.

Table 10: Summary of principal agent problems in delivery of ferry services

<b>Problems</b>	<b>Explanation</b>	<b>Mainly affecting</b>
Split responsibility for capital and operational costs	The entity investing in technical energy efficiency is different from the one bearing the cost of the energy efficiency.	Operate-only contracts
Short term tendering periods compared to life of ships	According to EU tendering requirements there is a disconnect between the duration of ferry life and tender period durations.	Provide-and-operate contracts
Lack of information on energy efficiency of ships	Operational energy efficiency data is also seldom recorded and this lack of information is also due to lack of accurate measurement.	Operate-only contracts Time chartered ferries
Operators lack of full control over operations	Although in commercial control of the ship, the operator does not own the vessel nor employ the crew on-board ships in some cases	Operate-only contracts
Bareboat charter rates may not reflect energy efficiency proportionally	The savings in fuel costs made by the operator as a result of an energy efficient ship are not fully passed back to the ferry owner in the form of proportionally higher bareboat charter rates.	Operate-only contracts
Fixed schedules and passenger costs resulting in poorer energy efficiency	PSCs stipulate require strict adherence to service frequency, regularity and sailing times and passengers place a premium on faster speeds, whereas the fares do not take into account the negative effects from a wider, social or climate	Operate-only and provide-and-operate contracts

	perspective.	
Short term duration of time charters	Over 90% of time charters in shipping are for less than two years, therefore it does not permit operators getting payback from the investment in technical and some operational efficiency measures.	Time chartered ferries

## 7 Test of carbon cost modelling and economic cost modelling for commercial operations

UCL Energy Institute employs a variety of methods in its research including data analysis and modelling. These models have been used when predicting future scenarios related to maritime transport and global shipping trends. The outputs have gone on to influence policy development, such as the study of greenhouse gas emissions from ships (the Third IMO GHG Study 2014) commissioned by the International Maritime Organisation as an update to the Second IMO GHG Study 2009.

One of the models used in the institute is GloTraM (Global Transport Model), which is a techno-economic model that can produce estimates of international shipping's GHG emissions as a function of a macro-economic scenario (trade), price data (fuel and carbon) and other policy. Other outputs also include the impacts of policy on transport costs. GloTraM combines multi-disciplinary analysis and modelling techniques to estimate foreseeable futures of the shipping industry. The model starts with a definition of the global shipping system in a baseline year (2010) and then evolves the fleet and its activity in response to external stimuli (changing fuel prices, transport demand, regulation and technology availability). The conceptual framework used is shown in Figure 16.

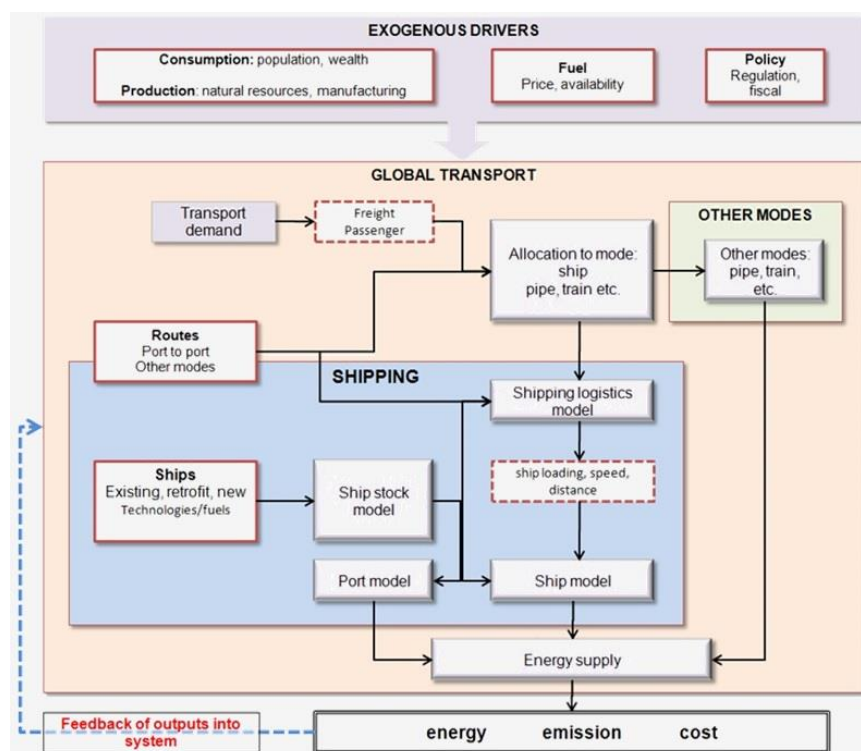


Figure 16: GloTraM<sup>19</sup>

<sup>19</sup> Details on the model, related publications and documents are available from [www.lowcarbonshipping.co.uk](http://www.lowcarbonshipping.co.uk)



The GloTraM model is underpinned by rigorous analysis of the existing fleet, along with the economics of technology investment and operation in the shipping industry. This approach ensures that the model closely resembles the behaviour of the stakeholders within the shipping industry and their decision making processes to ensure realistic simulation of their likely response to new external stimuli (such as introduction of a carbon price or carbon price fluctuations).

GloTraM was initially developed by the RCUK Energy programme and an industry (Shell, Lloyd’s Register, BMT and Rolls-Royce) funded project “Low Carbon Shipping – A Systems Approach”. It has since been further developed through a number of further projects including the project “Shipping in Changing Climates”.

The model has applications for greenhouse gas mitigation policy development (both Command and Control and Market Based Measures) on global (International Maritime Organisation), regional and national scales. In addition to policy impact, the model is in use in a number of multi-national organisations for assistance in strategic decision making. To date the model has been used to inform the International Energy Association (IEA) on future shipping trends, Lloyds Register and Shell on alternative fuel scenarios. The model also analyses a number of non-GHG emissions and air pollutants, for which there are also policy applications.

As a result of leading the IMO Third GHG Study in 2014, UCL Energy Institute now has an additional suite of models and data (for an example of this type of data, see Figure 17) for ferries that can be used to characterize the EU ferry sector at a more granular level. The EU sea regions have some of the highest coverage quality with this type of data, due to the large number of shore base stations. Using the models developed for the IMO 3<sup>rd</sup> GHG Study, this data can now be used to assess fuel use and CO<sub>2</sub> emissions in EU North Sea Region as well as historic trends of these (Figure 18, Figure 19, Figure 20).

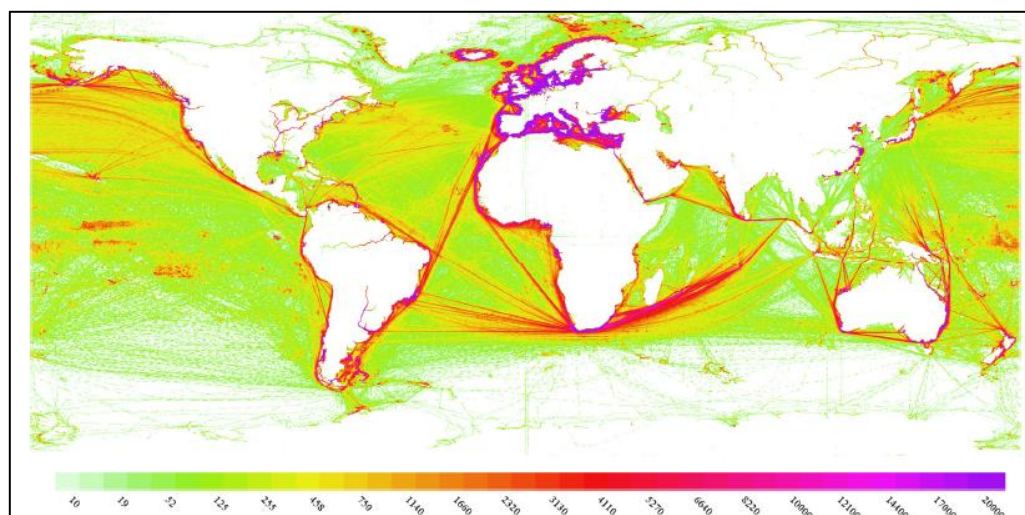


Figure 17: Chart showing the coverage AIS datasets used in this IMO Third GHG study



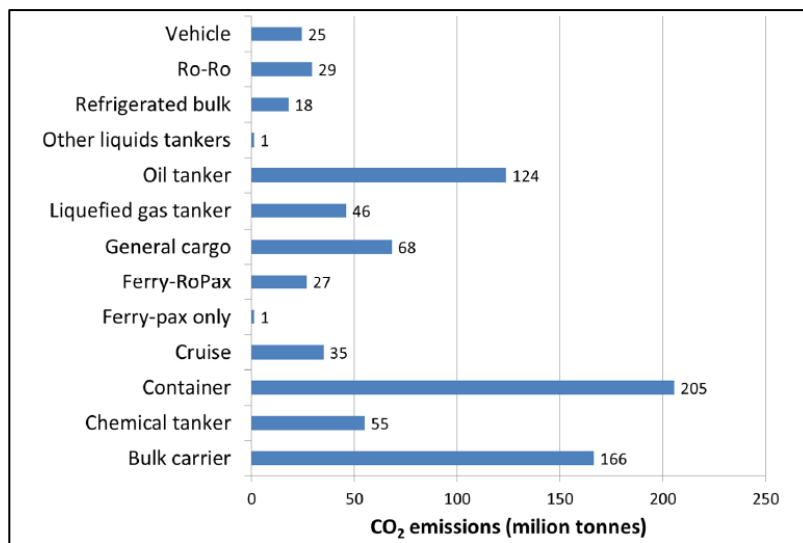


Figure 18: Bottom-up CO<sub>2</sub> emissions from international shipping by ship type 2012 (Source: Smith et al. (2014))

Data from 2012 shipping information (Figure 18) identifies that ferries deliver 28 million tonnes of CO<sub>2</sub> emissions, and this represents a small proportion of the total emissions from international shipping. Fuel consumption within the ferry sector, as with other ship types, predominantly originates from the main engines (Figure 19).

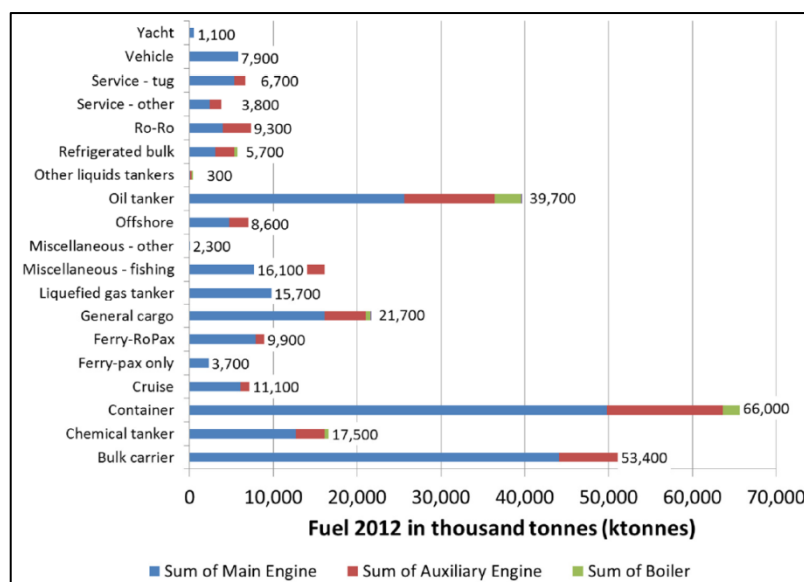


Figure 19: Summary graph of annual fuel consumption broken down by ship type and machinery 2012

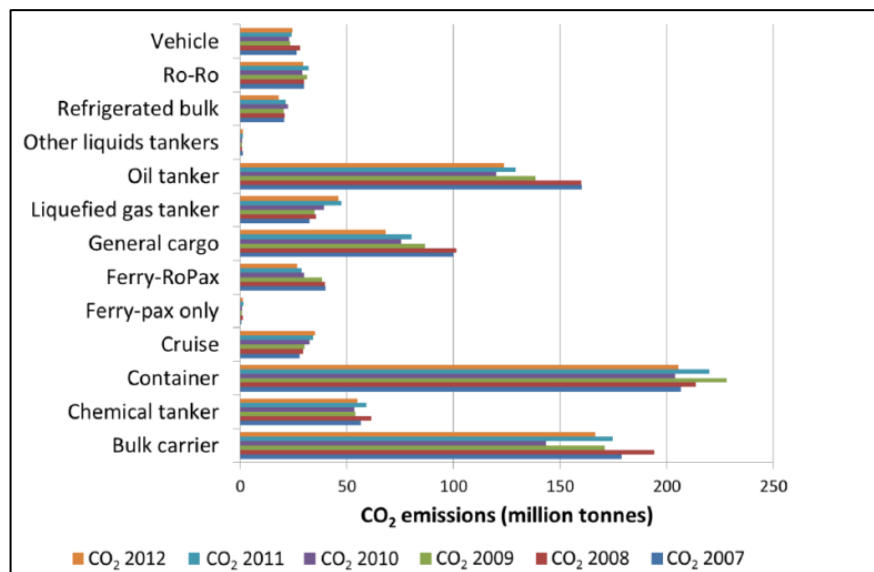


Figure 20: CO<sub>2</sub> emissions by ship type (international shipping only) calculated using the bottom-up method for all years (2007–2012).

Historical trends reviewing global CO<sub>2</sub> emissions from the shipping industry demonstrate that between 2007 and 2012 the emissions from RoPax ferries have decreased. This could reflect the increases in efficiencies that have been delivered by operators, or reflect the challenging financial conditions of ferry operations that has led many lines to reduce their routes, so the trend reflects not a greening of the ferry sector but a reduction in ferry services available.

The addition of ferry data into the 3<sup>rd</sup> IMO GHG report enables further research into this data set to uncover the trends and future directions and challenges for the ferry sector. These global trends will help EU policy makers and ferry operators to understand priorities for action when it comes to operations and application of innovation. While the global contribution to GHG emissions from the sector may be small, it is still important to focus on the improvements that can be delivered and the opportunities for ferries as an innovation test bed.

Smith (2012) presents a modelling framework that can be used to examine the technical energy efficiency and its economic interaction and simulate what might be commercially optimum in foreseeable future scenarios. The results suggest that operation to maximize a ship owner's profits negates the benefit in emissions reductions achieved through technology. If the mitigation actions of technology are both to be optimized and protected from potential operational rebound affects (speed increases), it is important to understand these interactions and take them into account in the design of GHG-related policy.

A current trend from the freight sector is the increase in 'slow steaming'. This entails reducing the speed of bulk cargo ships, increasing the shipment times, but reducing the power outputs, delivering fuel and cost savings. A similar approach could be taken in relation to ferry operations. If timetables and contracts could be amended to enable a reduction in crossing speed and an increase in transfer times, this could realise additional financial and environmental benefits, for operators. For example, the Scottish Government estimate that in a large ROPAX ferry a speed reduction of

0.5 knots would result in 20% reduction in CO<sub>2</sub> emissions whilst only adding five minutes to a two hour journey (Scottish Government 2011).

The carbon cost model available could be of significant benefit for the ferry industry as they look to realise efficiency savings and deliver sustainable transport choices for their passengers.

## 8 Development of a business case for a post project “low carbon shipping group”

By linking the iTransfer project with UCL Energy Institute a natural link to the low carbon shipping network was achieved. UCL Energy Institute was one of the first universities in the UK and the EU which established this group through its involvement in the ‘Low Carbon Shipping – A Systems Approach’ project funded by the UK Research Council (RCUK EP/H020012/1) in 2009. The project brought together five universities and key industry partners such as Lloyds Register, Rolls Royce, BMT, Maersk and Shell. This network has been fostered since to contain the leading industry and academic institutions and this has been accelerated with a follow up RCUK funded project, Shipping in Changing Climates, a ~£4m multi-university and a cross-industry partnership project. The group has in its portfolio some high profile projects, including the recently completed ‘IMO Third GHG study’ and Lloyds Register Global Marine Fuel Trends and various others, details of which can be found at [www.lowcarbonshipping.co.uk](http://www.lowcarbonshipping.co.uk). The group continues to forward its agenda on low carbon shipping through its quarterly forums and annual academic & industry conferences.

The common link established, through the UCL Energy Institute, between the iTransfer project partners and the Low Carbon Shipping Group and Shipping in Changing Climates project has facilitated a valuable knowledge exchange. The iTransfer partnership has gained access to a large amount of detailed research data, testing and knowledge relating to carbon reduction and emissions control in the global shipping area while, at the same time, the Low Carbon Shipping Group and Shipping in Changing Climates project have had access to the knowledge and experience of ferry operators within the iTransfer project, providing data and information from real-world situations in the ferry sector. This has become especially pertinent since the UCL Energy Institute have recently been able to include AIS data specifically relating to ferries in their information gathering and modelling. It is anticipated that the links and relationships established will continue beyond the lifetime of the iTransfer project, with partners participating in a continuing low carbon shipping group.

### 8.1 Wider impacts and bringing innovation to the South Pacific

Work conducted by UCL Energy Institute (as a subcontractor to Institute for Sustainability) in work package five contained a report that examined EU ferry policies with specific focus on public procurement and tendering of ferry services in the North Sea Region and the sustainability issues (specifically energy efficiency and GHGs) in the procurement of ferry services. UCL Energy Institute has subsequently partnered with University of the South Pacific (USP) a regional university servicing 12 Pacific Island countries, to leverage on the findings generated in iTransfer to investigate similar issues for Pacific Island countries and communities. Such communities rely heavily on relatively small and generally old ferries as their primary transport mode between the islands. The Pacific is the most dependent region in the world on imported fossil fuels (more than 95% dependent) and over 70% of the fossil fuel consumption in the region is for transport fuels. For some countries maritime transport is the majority fuel user and for all a significant user.<sup>20</sup>. Thus the

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<sup>20</sup> Nuttall, P., et al. (2013). A review of sustainable sea-transport for Oceania: Providing context for renewable energy shipping for the Pacific. *Marine Policy*: 43: 283–287

efficiency of ferries is crucial for these Small Island Developing State (SIDS). Moreover the need to investigate energy efficiency in publicly provided ferry services are of a high importance to the islands as it attempts to build resilience or 'climate change proofing' for the island and its communities. On the other hand the ferry transport in the islands will also be adversely impacted by the forthcoming international regulations such as SOx emissions (MARPOL Annex VI) which will contribute to an estimated 60%<sup>21</sup> increase in marine fuel costs. Recent UNCTAD analysis confirms that such SIDS will be disproportionately affected by such price increases comparative to all other countries and regions<sup>22</sup>.

Currently ferry transport is limited to infrequent commercial ferry services (in most parts of the island) and outboard driven punts. The Fiji Government, for example, subsidises the ferries through its Shipping Franchise Scheme to ensure commercial operators service those routes classified as 'uneconomic', for which there would otherwise be no regular services or physical connectivity. The routes operating subsidised ferries are of twice the replacement age (e.g. MV Sandy Lady, MV Spirit of Fiji Islands) compared to newer efficient ferries that operate on economical routes<sup>23</sup>. The disconnect in efficiency of ferries suggests that there may be similar challenges (to that being faced in the North Sea Region) which is faced in many parts of the world where public procurement of ferries takes place. Poor strategic procurement decisions in recent years in several Pacific instances have seen unseaworthy vessels founder with subsequent tragic loss of life. Initial consultation with Pacific stakeholders at regional agency, government and industry levels indicates a strong interest in this field and a desire to learn from lessons being developed elsewhere.

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<sup>22</sup> UNCTAD (2014) *Review of Maritime Transport 2014*, UNCTAD/RMT/2014

<sup>23</sup> Fiji Government, *Fiji shipping franchise scheme*, viewed 29 November 2014,  
<<http://www.unescap.org/sites/default/files/l.4.Fiji-shipping-franchise-scheme.pdf>>.

## 9 Concluding remarks and policy recommendations

This report presents for the first time a systematic analysis of the sustainability issues faced in the public procurement of ferry services. Using the principal agent theory and framework developed in similar studies in other sectors, the report highlights potential problems that are being faced by stakeholders in the procurement process of ferry services in EU, energy efficiency and CO<sub>2</sub> emissions. Existing research has shown that in some EU ferry services there exist up to 30% cost efficiency gains, suggesting production costs (e.g. labour, capital, fuel) are not minimised, thus energy efficiency savings and CO<sub>2</sub> emission reductions are foregone. According to the foregoing analysis this arises mainly as a result of the capital and operating costs being divided between the different entities, where the operator bears the operating costs (including fuel cost) and the owner bears the capital costs, arising either as a result of different type of charters or provide-and-operate and operate-only contracts. This is further exacerbated due to multiple principal agent relationships in the delivery of ferry services and some peculiarities of the public procurement processes (e.g. clawback mechanisms). There was inconclusive evidence on whether the limited tendering periods actually disincentivise investment in newer and energy efficient ferries. This is one of the areas where further work is clearly beneficial. Further data can be obtained through interviews with industry stakeholders to provide a more complete and valid picture of the issues presented.

CO<sub>2</sub> emissions from the ropax and pax-only vessels represented around 3% of shipping emissions in 2012 and given the growth of the sector in the last two decades, it is likely that this proportion will increase in response to increase in demand and absence of policies, despite the efficiency gains and technological innovations in the sector. To some extent the regional EU MRV regulation is the first policy instrument aiming to address CO<sub>2</sub> emissions, although the efficacy of the policy is debatable. The Energy Efficiency Design Index (EEDI) for ferries being discussed at IMO (mandatory for other new-build ships since 2013) would create further incentives for ferry owners and operators to improve the design efficiency of the ferries and to some extent will address the split in cost for owning an energy efficient ferry and operating an energy efficient ferry. The most important policy could be to improve the operational or in-service efficiency of ferries, which would bring energy efficiency and sustainability to centre stage in the public procurement of ferries. This could be achieved from various instruments ranging from command and control measures to market based measures that put a price on emissions, therefore internalising the social or environmental costs and incentivising efficient operations. The implications and effectiveness of such a policy need to be carefully considered, given the pervasiveness of the principal agent problem in the public procurement of ferry services.

If energy efficiency and climate change are important to both the member states and EU then there needs to be a holistic approach to public procurement of ferries. Whilst there have been attempts to incorporate sustainability through energy efficiency in tenders, much more could be done to highlight its importance. When there aren't economic incentives (as highlighted in the report) to conserve fuel due to various reasons, then there is a greater need for a policy to drive implementation of energy efficiency. As an example standard policies could be adopted that

specifically score bids on energy efficiency, rather than scoring on broader 'quality' or 'environment' criteria.

Innovative financing models that require zero capital expenditure from the ferry owner and operator can be instrumental to overcome split incentives that arise as result of contractual arrangements and duration which affect the implementation of some energy efficiency measures requiring larger initial outlay.

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## 11 Appendix

Table A1: An example of the split in responsibilities in a call for tenders in the context of Scottish ferry services

Source: The Scottish Government (2003)

Operator	Executive/VesCo	Shared/ Negotiable	Comment	
Vessel design	✓			
Vessel construction/leasing	✓			
Commissioning risk	✓			
Operational risk(vessels)	✓			
Policy risk			✓	Policy risk not involving legislation
Demand for volume risks	✓			Risk that demand for service does not match the levels planned
Maintenance risk for harbours		✓		Primarily for VesCo
Maintenance risk for vessels	✓			
Inflation risk			✓	
Legislative risks			✓	Depends on circumstances. Corporation tax, etc., would fall to operator. Scottish Executive legislation would be public sector. MCA Regs may be either depending on the circumstances
Change in requirements of transport policy		✓		For example, a change in EC or Govt policy in relation to subsidisation of shipping operators
Incorrect cost or time estimates for providing services	✓			
Failure to meet specified service levels	✓			
Force majeure			✓	
Industrial action	✓			For contractor's staff in relation to CHFS contract. See section on relief events in relation to industrial action outwith the contractor's control

Failure to meet performance standards	✓			
Capital expenditure - Vessels	✓			The operator responsible for provision of vessels.
Capital expenditure - ports		✓		
TUPE costs at start of contract			✓	Tenderers are asked to bid as if TUPE applies and therefore subsidy will reflect this. However, any errors in the bid will fall to operators

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